Petroleum Processing

INCLUDING PETROCHEMICAL SECTION FEBRUARY, 1955

COMPUTERS IN REFINING? These men say 'Yes' and point out why—p. 189

DIVIDENDS IN MAINTENANCE—by planning and scheduling . . . . . p. 192

FUEL SENSITIVITY—Key to road performance ratings . . . . . p. 211

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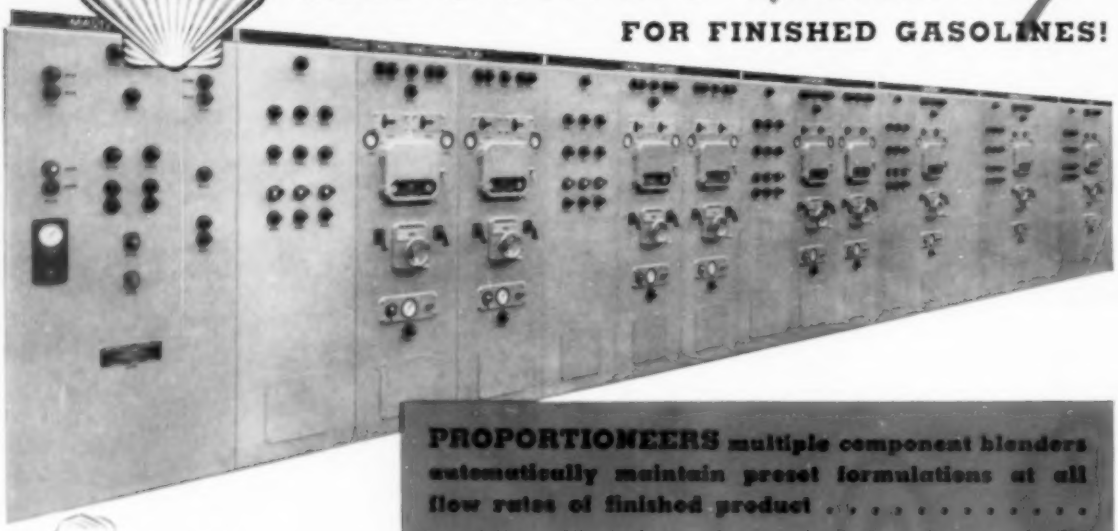

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Petroleum Processing

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals.

February, 1955
Vol. 10, No. 2

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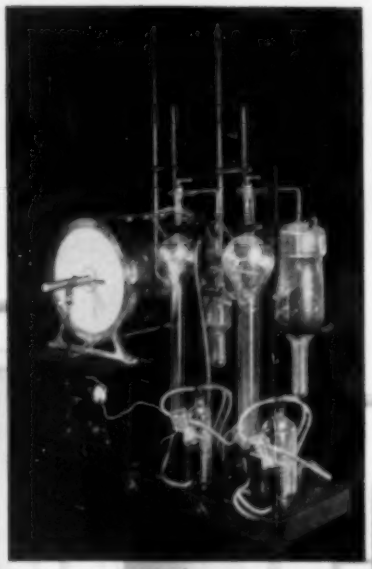

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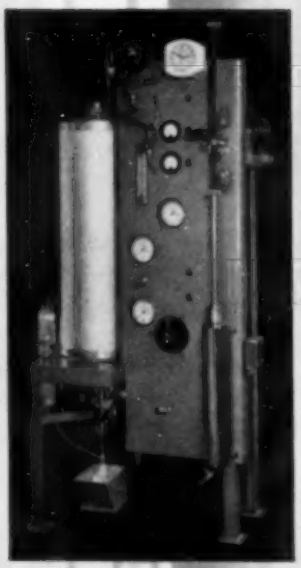
- Detects catalyst poisoning

for research laboratories

- Evaluates new catalysts



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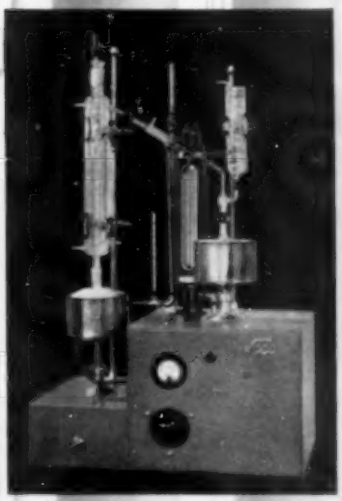
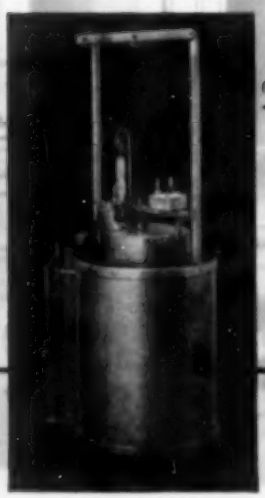


↑ *Hempel Column*



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Petroleum Processing

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When the Cat's Away, the Mice Will Play

WE ARE not mice: we are editorial staffers. And the editor is no cat. But his is away — on a vacation. And it is deadline time for this page. So what better time than to tell you a little bit about Bill Bland, editor of PETROLEUM PROCESSING, who has been using this page in the past to tell you about some of us.

The kind of a vacation Bill is taking is, we think, rather typical of the kind of a guy he is. If you were to drop in on him at his home in Stamford, Conn., he'd probably greet you at the door, hand you a hammer or a saw, and say: "Ah! Just in time to help me finish rebuilding my kitchen." That's what he's doing during this current vacation, and what he likes to do in all his "spare" time.

His wife, Dorothy, and the three children — Susan, eight; David, six; and Mary Ellen, three — have simply learned to put up with Daddy in his old clothes doing anything from carpentry to plumbing to electrical work. (No welding yet, though he has done some occasional brazing). As a matter of fact, we have it on confidential authority that the start of the current "do-it-yourself" fad has been definitely traced to a little, long-forgotten job Bill Bland did many years ago.

Statistically, William F. Bland is a ten-year man with our staff. He joined the old predecessor to PETROLEUM PROCESSING, the technical section of *National Petroleum News*, back in 1944. Before that, he was in engineering work with the Goodyear Aircraft Corp. and with Hydraulic Equipment Co., and also spent some time helping Tremco Mfg. Co. promote its maintenance products.

A 1940 engineering graduate of Fenn College in Cleveland, Bill got the editorial bug early in life. Editor of the college weekly, he carried the bug on after graduation by joining with a friend in a small commercial publishing enterprise — a little magazine for specialists in one phase of stamp-collecting. This was fine for "pin" money, but Bill got hungry once in a while, and when Akron and Goodyear beckoned with a living income, the publishing bug went into dormancy.

However, once a man is bitten it's tough to shake off the idea. So, by 1944, Bill went back to Cleveland and joined this outfit. We of the staff and his many friends in the industry are glad it worked out that way.

Incidentally, if that kitchen rebuilding job sounds impressive, we should point out that a few years ago Bill bought an old house and virtually rebuilt the whole thing — adding a bedroom, utility room, bathroom, sun porch, and front porch (Sorry! the porch never did get finished!)

William C. Uhl

Managing Editor

Other McGraw-Hill Petroleum Publications

National Petroleum News
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A daily independent oil-news reporting service issued from New York, Chicago and Houston.

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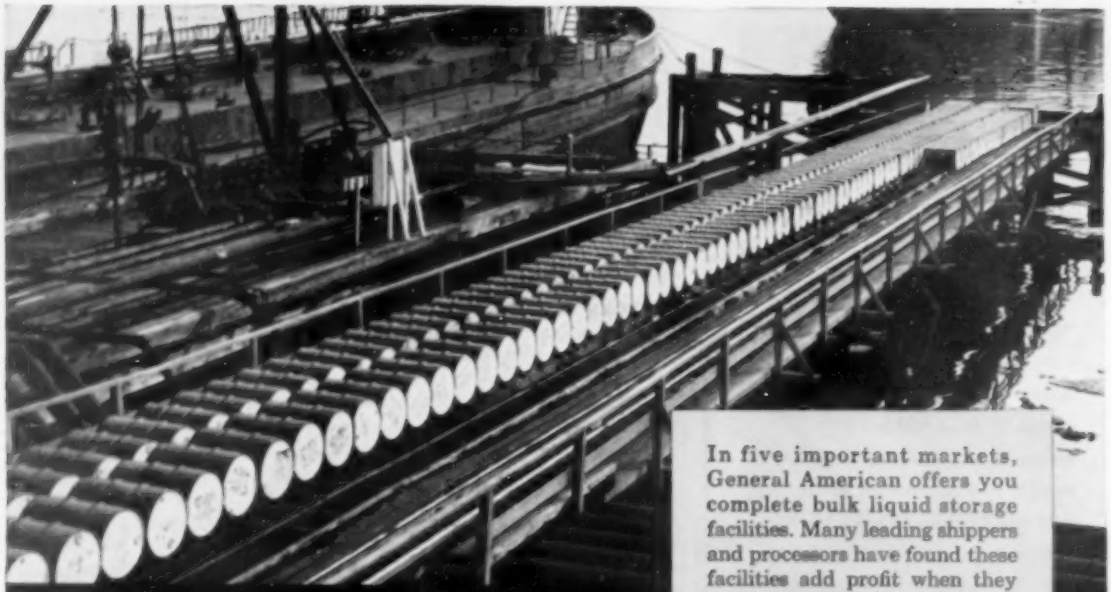
A daily independent oil-price reporting service issued from New York, Chicago and Houston.



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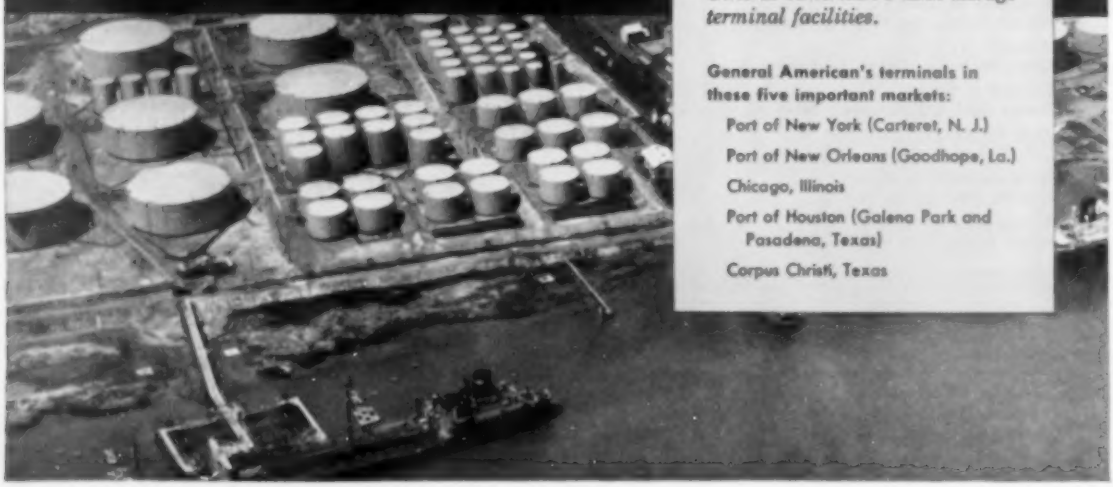

What's Happening

in Refining

. . . **Supply-demand forecast by Bureau of Mines** sees a gain of 4% in domestic demand and decline of 16% in exports, making 3% increase in total demand for all oils in 1955. Actual figures were: overall total demand, 8,351,000 b/d; domestic, 8,058,000 b/d; and exports, 293,000 b/d.

Breakdown by product, on domestic demand, was: gasoline up 3.2%, residual fuel oil up 2.5%, distillate fuel oil up 5.7%, kerosine up 2.5%, other oils up 6.6% (including 34% up for jet fuels and 3.2% for others).

. . . **New construction projects** approved for fast tax write-offs recently include the following:

Humble Oil & Refining Co., $3,750,000 for a new 18,000 b/d platinum type catalytic reformer, and $799,000 for a 30,875 b/d catalytic desulfurization feed treater, at Baytown, Texas.

Fletcher Oil Co., $976,000 for a 10,000 b/d crude topping unit and auxiliaries at Wilmington, Calif.

Magnolia Petroleum Co., $299,800 for natural gas and liquid recovery facilities in Calcasieu Parish, La.; and $1,366,800 for natural gas processing and transmission facilities in Midland County, Texas.

. . . **Standard Oil Co. of Texas** has awarded Bechtel Corp. contract for construction of a 4500 b/d catalytic reformer at El Paso, using design by California Research Corp.

. . . **Texas Gas Corp.** will install a 2500 b/d UOP Platformer at Winnie, Texas, gasoline plant to permit production of premium-grade motor fuel, charging straightrun naphtha from casinghead gas and distillate recovery. Engineering design has been completed by UOP, and Procon, Inc., has begun construction, with completion scheduled for about May 1.

. . . **Sioux Oil Co.** will expand two refineries at Newcastle, Wyo., from 4000 to 5000 b/d total capacity and build 55-mile products line to Rapid City, S. Dak., under $4,000,000 expansion in 1955.

. . . **International Waxes Ltd.** has started construction of a $350,000 contact plant in Toronto for refining and producing petroleum waxes, said to be the first continuous yield plant in the world, and increasing capacity to about 140,000 lb/day.

. . . **Shell Oil Co. of Canada Ltd.** will spend $4,000,000 in an expansion program at its Montreal East refinery, with completions scheduled for late in 1955. Project, described as an intermediate step in overall program to raise capacity ultimately from 44,000 to 55,000 b/d, includes: a new vacuum flasher and raising capacity of the cat cracking unit from 16,500 to 19,500 b/d. Arthur G. McKee Co. of Canada Ltd. has contract on flasher, and Shell's engineering staff is handling the cat cracker.

. . . **British-American Oil Co.** will build a 13,000 b/d, $3,000,000 Atlantic "Catformer" at Montreal. Lummus Co. of Canada Ltd. has construction contract. Completion is scheduled for late 1955.

. . . **Husky Oil and Refining Co. Ltd.,** will install two Atlantic "Catformers" of 1000 b/d capacity each, at Moose Jaw and at Fort William, Sask. They are scheduled to start up in July.

. . . **Negotiations for two new catalytic cracking** units, one in Oklahoma and one in Canada, are reported near completion by the new Succop Engrg. Co. of Los Angeles. They will be of a modified TCC design developed by Succop under Socony-Vacuum license.

in Petrochemicals

. . . **Simpson Coal & Chemical Corp.** is planning a $20,000,000 natural gas-acetylene plant, integrated with ammonia and vinyl chloride monomer and polymer, on the Mississippi near Natchez. Projected acetylene capacity is 30,000 ton/yr. (using Sachsse variation), and ammonia is 60,000 ton/yr. Completion is expected by mid-1956.

. . . **Northern Chemical Industries'** $9,000,000 projected ammonia plant for Searsport, Me., will be the first using exclusively the Texaco-Hydrocarbon Research process for synthetic ammonia from Bunker C fuel oil by partial oxidation with oxygen. Girdler Co. has prime contract for a 125-ton/day anhydrous ammonia plant, 60 ton/day nitric acid unit, a nitrogen solutions plant and a power plant.

. . . **All but three government rubber plants** had been sold by the Rubber Disposal Commission by deadline time. Industry experts estimate total value of the 24 contracts at $295,000,000.

. . . **Ammonia in South America** — Helios, S. A., has expanded its refinery building program at San Andres, Peru, to include a fertilizer plant making 130,000 ton/yr of ammonia nitrate.

. . . **Stanolind Oil & Gas Co.** has signed an exclusive contract with R. W. Greef & Co., Inc., New York, for marketing the anticipated 125,000,000 lb/yr of chemicals from its Brownsville, Texas, plant, which is expected to begin operations in fall of '55.

. . . **Imperial Chemical Industries** plans expansion of Billingham, England, plant for manufacturing higher alcohols by the carbonylation process.

. . . **Ethyl Corp. of Canada, Ltd.**, plans a new TEL manufacturing plant at Sarnia, Ont., first antiknock making facilities to be built in Canada.

in Foreign Operations

. . . **Petroleos Mexicanos** will invest about $40,000,000 in modernization over next several years, including a new cat cracker and boiler plant at Madero; raising Salamanca capacity from 10,000 to 40,000 b/d; Atzcapotzalco from 50,000 to 80,000 b/d; a pipeline from Tampico to Monterrey, and finishing current project at Reynosa.

. . . **Petrobras,** government oil monopoly in Brazil, plans expansion of the Mataripe (Bahia) refinery to 15,000 b/d; construction of a new refinery in Belem or Recife with capacity of 25,000 b/d; expansion of the Cubatao refinery to 70,000 b/d.

. . . **American Mediterranean Refining Co.** will begin operating its new 6000 b/d, $6,000,000 refinery at Sidon, Lebanon, about end of February. Medreco also plans to invest an additional $2,000,000 this year, including a second Platformer, and to expand to 9000 b/d in 1956.

. . . **Refineria de Petroleos de Escombreras, S. A.,** plans expansion of its 36,000 b/d refinery near Cartagena, Spain, to about 70,000 b/d.

. . **Neste Corp.,** Finnish government-owned, will build a 14,000 b/d refinery near Turku, Finland, for about $17,500,000, and is entertaining a bid for construction by Soviet Russia engineers.

. . . **The Jordan Board of Development** has decided to build a $3,000,000 refinery of undisclosed capacity at Amman, Jordan, by end of 1955.

. . . **Raffineries de Petrole de la Gironde,** will spend $8,300,000 expanding Bec d'Ambres, France, refinery, including cat cracker, vacuum still, cat poly unit.

. . . **A refinery in Costa Rica** is being considered as a joint investment by the government and private investors. Petrotico, S.A., a private company, has been organized for the purpose. Government sources in San Jose state the proposal has been advanced by J. S. Martin, Washington, D.C.

in Markets and Prices

. . . **At mid-January** there was little for refiners, terminal operators and traders to complain about on movement of products and prices generally.

. . . **Exception in Chicago,** even gasoline was in overall good balance as refinery runs were held back and distillate yields maximized. And, even at Chicago trade talk indicated gasoline prices had hit bottom and were about ready to come back.

One of the principal developments that pointed to what refiners are thinking about in the way of higher gasoline octane ratings was introduction at the Gulf of 90 oct. regular and 97 oct. premium.

This brought speculation as to how hard the clash might be this spring between "river" gasoline and "pipe line gasoline" in Midwest areas where they compete, such as Chicago and Minneapolis-St. Paul. Meanwhile, Great Lakes Pipe Line shippers were considering advancing octane ratings for premium gasoline 1 pt. to 93, but no change was contemplated in 84 oct. for regular grade.

. . . **Gulf Coast prices for all light fuels** went up another 0.25¢, while Group 3 prices for northern shipment advanced 0.125¢ to 0.375¢. Prices at pipe line terminal points also advanced and were held generally at "0.25¢ over" delivered costs north of Kansas City despite increases at input point.

Some shippers also were thinking in terms of another 0.125¢ advance for "pipe line gasoline." They said, however, that much depended on stock position, refinery runs, and distillate yields.

General strength in light fuels and need for higher distillate yields were recognized by Standard of Indiana just before start of year when it advanced tank wagon (retail) prices 0.3 to 0.5¢/gal. in most states in which it markets.

. . . **Strength in heavy fuel** was pointed up by refiners' increases to $1.50, Group 3, from $1.40. Although product for most part was closely held, traders said price hike released enough material to open market to create good supply-demand balance.

in Labor and Law

. . . **Prospects are for still more union strength** in expected move to merge International Chemical Workers Union (AFL) with OWIU and United Gas, Coke & Chemical Workers (both CIO) soon after latter two complete their own merger plans this month.

. . . **Texas Supreme Court has ruled** that city of Deer Park, near Houston, cannot annex property owned by Shell Oil Co. and Shell Chemical Co. City attorneys plan to seek another hearing. Ruling is said to apply only to efforts of cities to annex territory where no voter lives.

Looking Ahead

. . . **Esso Research and Engineering Co.** is new name for Standard Oil Development Co.—research arm of Jersey Standard—effective Feb. 3. Change was decided on to make company's name more descriptive of its activities.

. . . **Atomic energy in chemical processing** applications will be studied by Diamond Alkali Co., particularly on such reactions as polymerization, oxidation, and chlorination.

. . . **Gas-turbine autos loom closer.** Ford has joined GM and Chrysler as researchers in the field (reported at Society of Automotive Engineers' meeting in Detroit last month).

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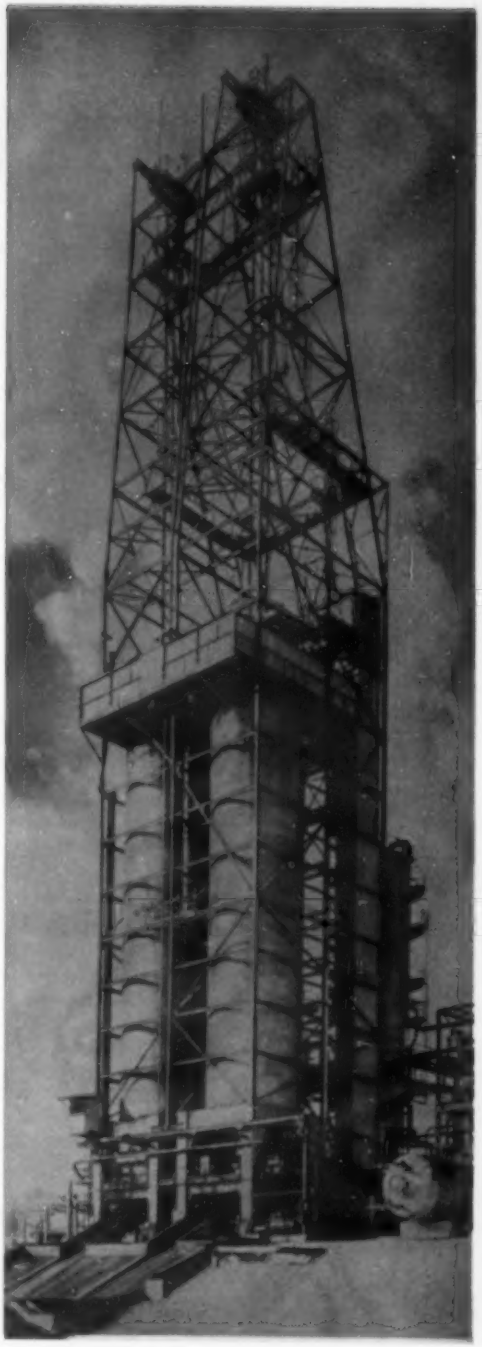

Lummus has built two delayed coking units for Pan-Am Southern Corporation in the past few years, one at El Dorado, Arkansas, and the other at Destrehan, Louisiana... and Pan-Am Southern is well satisfied with them.

The El Dorado unit, despite a 42 day steel strike during the construction period, was completed ahead of the specified date, and for less than the guaranteed maximum cost. It was designed to charge 9,300 B/D of reduced crudes, but since coming on-stream, the daily rate has averaged 10% above the designed capacity. The unit went on-stream immediately and operated 181 out of the first 199 days after completion (a 91% service factor). In the first half of 1953, it achieved and has since averaged a 97% service factor (224 day run, 6 day down-time). On-stream maintenance and repair costs are correspondingly low.

Gas oil from the coker (53% yield of reduced crude charge) is used for catalytic cracking charge stock where its low Conradson carbon allows it to be processed without penalty. Yield structure compares favorably with that obtained from catalytic cracking of virgin gas oil. The coke produced in the process is of sufficiently high quality for use in the manufacture of electrodes for aluminum production.

The new (and similar) Destrehan installation is achieving equally satisfactory records.

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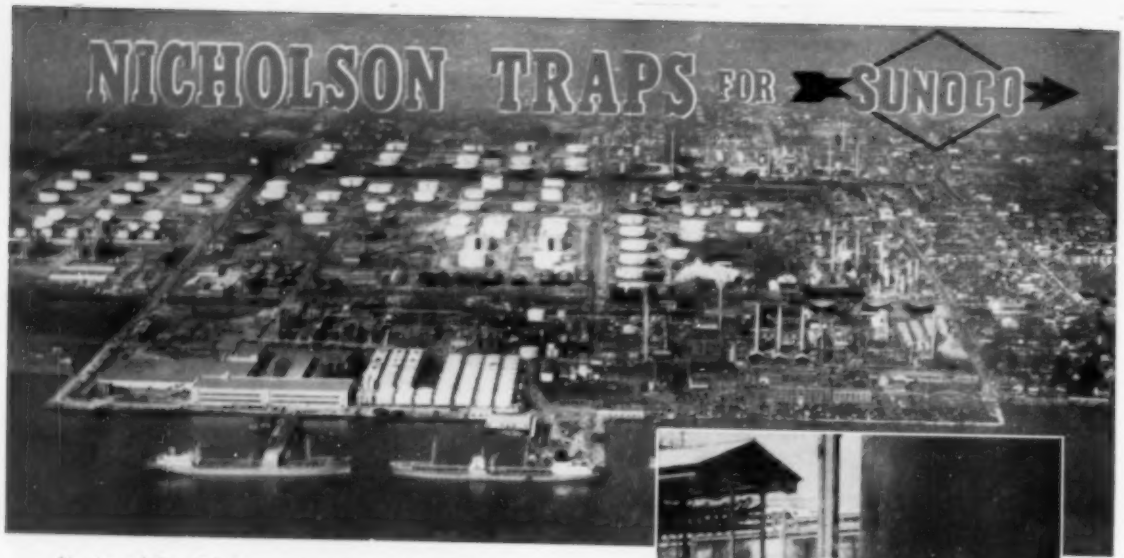

Air view of Sun Oil Company's refinery at Marcus Hook, Penna.

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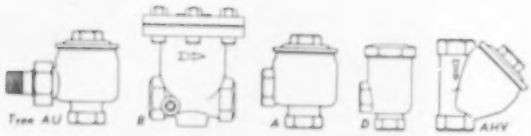

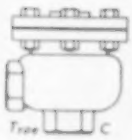

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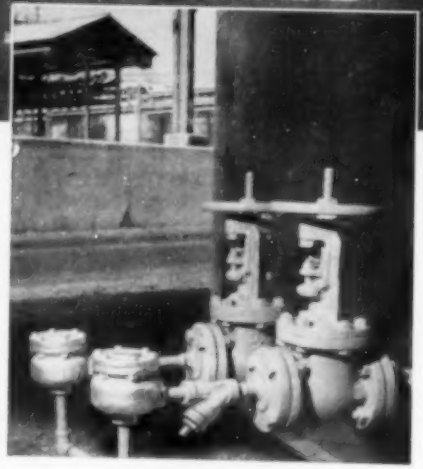

Nicholson steam traps are shown above installed on storage tanks requiring heating at Sun Oil Company's Marcus Hook, Pa., refinery. Sun has standardized on this type of installation.

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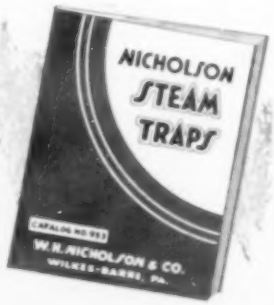

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Better Motor Fuel Consumption Through Smog Relief Program?

THE disclosure that hydrocarbons in automotive vehicle exhaust gases are the principal source of the discomfort and damage from smog in Los Angeles makes the finding of means to control these gases of wider interest than to just this one community.

When the car population in other areas becomes dense enough, the meteorological factors may exist to make smog at such areas more than a nuisance. A remedy for Los Angeles would have potential applications in such instances.

Los Angeles had no difficulties from smog before 1945.[1,2] There were 1,000,000 additional automobile registrations from 1944 to 1953. The 2,111,000 vehicles operated in 1953, burning about 4,500,000 gal. of gasoline daily, emitted to the atmosphere approximately 1200 tons of hydrocarbon compounds resulting from incomplete fuel combustion. This was almost one third of the organic contaminants from all sources contributing to smog discomforts.

By comparison, the estimated 440 daily tons of hydrocarbon compounds evaporated from production, manufacturing and distribution of petroleum makes oil company operations a relatively small contributor to smog conditions. Control of automobile exhaust gases at present stands out as the answer to the problem.

Los Angeles authorities believe, that to return to the relatively smog-free years prior to 1944, gasoline consumption would have to be cut back from 1.66 billion to 0.67 billion gals. "More realistically," it was stated, "automobiles must be equipped with devices which will curtail the hydrocarbon content of the exhaust by 60%." Logically, control would have to be effective to a higher degree as the car population grows. The Air Pollution Control District has recommended studies on this problem should strive for a 90% overall removal of hydrocarbons from exhaust gases under conditions of operation experienced in heavy traffic.

The automotive people have already made some progress in this line of attack on smog. Mass spectrometer analyses were made by the Research Laboratories Division of General Motors to determine the hydrocarbon content of engine exhaust gases over the normal driving range.[3,4] The content in wt.-% averaged from 1.5 at part throttle to 4% at idling and 12.5% at deceleration.

A further step along this line has been to test devices to reduce the volume of hydrocarbons in the exhaust during deceleration. "There are at least two ways to modify a carburetor" to accomplish this.

"1—The fuel flow may be shut off when the intake manifold vacuum exceeds about 21 in. Hg. 2—The vacuum may be prevented from reaching the values which give high concentrations of unburned fuel in the exhaust."

This then points to another consideration—the effect of these devices on fuel economy. "The device which shuts off the idle circuit during deceleration," it was stated, "has been found in preliminary tests to give 2.9% more fuel economy in all-around family driving. The vacuum limiting device has not been checked for fuel economy, but it is probably lower with the device in operation because more fuel is used during deceleration with the device in use than without it."

The petroleum technologists as well as the automotive engineers appreciate the difficulties of providing the mechanical means to eliminate all the waste hydrocarbons in exhaust gases or even to reduce them greatly. The possible double achievement of fuel conservation and smog reduction is expected, however, to stimulate studies to this end. —V.B.G.

(1) "A Study of Distribution and Effects of Automotive Exhaust Gases in Los Angeles" by Gordon P. Larson, John C. Chipman and Erwin K. Kauper, Air Pollution Control District, County of Los Angeles.

(2) "An Inventory of Automobile Gases" by Dale H. Hutchison and Francis R. Holden, Stanford Research Institute, Stanford, Calif.

(3) "Some Effects of Engine-Fuel Variables on Exhaust Gas Hydrocarbon Content", by F. G. Rounds, P. A. Bennett and G. J. Nobel, Research Laboratories Div., General Motors Corp.

(4) "Flame Photographs of Light Load Combustion Point the Way to Reduction of Hydrocarbons in Exhaust Gases", by J. T. Wentworth and W. A. Daniel, Research Laboratories Div., General Motors Corp.

The above papers were presented before the Golden Anniversary Annual Meeting, Society of Automotive Engineers, Detroit, Jan. 10-14, 1955.

Wide Range of Uses Brightens the Future for Dimethyl Sulfoxide

A NEW chemical with promising petrochemical potentialities is dimethyl sulfoxide. Recently introduced by Stepan Chemical Co. and presently in the pilot plant stage, the product is seen as possibly serious competition for a number of volume applications. And Stepan has been talking in terms of a 10,000,000 lb./yr. commercial plant in the future.

Notable among uses for dimethyl sulfoxide, a high boiling (189° C.), water-white, nearly odorless liquid, are: 1) anti-freeze, 2) paint remover, 3) reaction medium, 4) selective solvent for petrochemicals and fatty acid purification, 5) solvent for welding gas and synthetic fibers.

Most likely raw materials route is petrochemicals. Dimethyl sulfoxide is made by passing hot methanol and hydrogen sulfide over a catalyst to form dimethyl sulfide, which is condensed and purified by distillation. Methanol and H_2S are recovered and recycled. By-product methyl mercaptan could find outside uses.

The purified dimethyl sulfide is mixed with air and nitrogen dioxide at atmospheric pressure to form dimethyl sulfoxide in a series of reactors.

Anti-freeze qualities of the material are several. It is miscible with water and has a specific heat of 0.7 cal/g. Water solutions of the compound have lower freezing points than corresponding ethylene glycol solutions, it is stated.

In addition to its ability to dissolve many organic materials, dimethyl sulfoxide is compatible with other solvents such as ethanol, acetone, ether, benzene, and chloroform.

Another possibility along this line is use of the

materials as a selective solvent for recovering acetylene from pyrolized natural gas mixtures. Other gases soluble in the material include ethylene oxide, sulfur dioxide, hydrogen chloride, and nitrogen dioxide. As a selective solvent, the material has a high capacity for aromatics, sulfur-containing compounds, and unsaturated hydrocarbons, and a small affinity for paraffins.

Most important factor in its future commercially is cost. At the 10,000,000 lb/yr. output, it is expected to sell for about 25¢/lb. Although not regarded as excessively high, that is a fairly rugged figure in the solvent business. The price range of acetone and of ethylene glycol, 10 to 15¢/lb., would require production of dimethyl sulfoxide to get into the neighborhood of 100,000,000 lb/yr., and that won't be happening overnight. —W.C.U.

(1) "Banking on Solvency," Chemical Week, January 15, pp. 62-64.

New Process Holds Promise for Chlorinated Hydrocarbon Makers

PRODUCERS of chlorinated hydrocarbons may be soon taking a closer look at a recently-announced adaptation of the classic Deacon method of releasing chlorine from hydrogen chloride. It retains the advantage of the old Deacon technique by making it possible to chew up all the hydrogen chloride without the necessity of special handling for recovery or disposal as a by-product. Added features are greatly improved catalyst efficiency and lower operating temperatures.

Headache of the chlorination reaction is that twice the amount of chlorine is required in the substitution reaction over the amount actually present in the chlorinated product. The "excess" is tied up as hydrogen chloride and usually is so dilute that transportation over any great distance is not a practical means of disposal. Concentrating the HCl is expensive. Neutralizing it with caustic produces another hard-to-sell by-product. As a consequence, this is not the first time the Deacon reaction has seen attempts to improve once-through catalyst efficiency.

The new process follows the old Deacon in retaining the copper catalyst (originally cuprous chloride). However, in this variation, the metal is deposited as the oxylate on an alumina base, thereby keeping the copper dispersed and permitting a reduction in the catalytic oxidation temperature to 512-521° F. (245-250° C.). This, in turn, has boosted conversion of HCl to 90%.

Processwise, the chlorine regeneration step can be combined with the chlorination reaction in vapor phase as a continuous process. Needed are three reactors, two to three separators: one reactor serving as the chlorinator and the second as the chlorine regenerator (the third is a standby for use when the second reactor is being regenerated). The separators knock out any HCl and/or chlorine. Chlorination may be carried out in the chlorine regenerator also.

In monetary savings, Aaron Teller of Fenn College, who developed and discussed the Deacon modification,[1] calculates that the increase in chlorine utilization efficiency will save producers $9.30/ton of substituted chlorine plus the investment for recovery equipment.

Principal drawback to the process is that thus far it has yet to see large-scale trial, though a number of large companies have been reported interested.

What is needed: pilot plant studies, particularly with hydrocarbons other than benzene (with which Teller made his small-scale runs). It is believed that there will be no corrosion or other problems, but confirmation will have to come from the pilot plant, where such additional refinements as the adaption of moving-bed techniques may prove to be attractive. —D. P. T.

(1) Teller, A., "Utilization of By-Product Hydrogen Chloride as a Chlorinating Agent," 47th annual meeting, American Institute of Chemical Engineers, New York, December 12-15, 1954.

Solar Energy Is Study Topic In "Original Thinking" Course

NEARLY all college curricula have conventionally been geared to meet the needs of the average students and to provide help for the poor student while neglecting to a certain extent the "brilliant minority."

Realizing that these relatively few brilliant youngsters may well be the leaders in planning and building tomorrow's world, Dr. Elmer C. Easton, dean of the College of Engineering at Rutgers University, and his colleagues, decided to devote more time to their problems.

"Too many young men fear new ideas; they are afraid of possible failure and subsequent ridicule, and consequently their imaginations are dull and rusty. We hope to give those imaginations plenty of exercise and a free rein," Dean Easton said.

Vehicle for this ambitious project is an "honors project" in which eight top-ranking students have voluntarily enrolled. Its purpose is to encourage creative thinking coupled with a firm base of engineering fact and know-how.

Electricity from solar energy was the field of investigation chosen by the student group for study. Their first instructions were in the use of library research and reference facilities. Then, the five assisting professors helped in the correlation of the research material developed by the student group. Final step in the project will be to construct a working model based upon the composite ideas of the entire group.

Flights of fancy are encouraged once weekly in this project by a course entitled "Applied Imagination" and taught by Dean Easton. Its purpose is to loosen minds from conventional "ruts" and to encourage the students to conceive new ideas.

Aside from the fact that once again scientific attention is being paid to wresting energy from the sun, it is interesting to note the use of this "wild-idea" technique to the development of new knowledge.

Oil is still a prime energy source for today's way of life. Yet, it grows increasingly evident that with new information pouring out of the world's research centers—both industrial and institutional—on such alternate and highly prolific sources like the sun and the atom, oil can expect some intriguing competition. —R. L. D.

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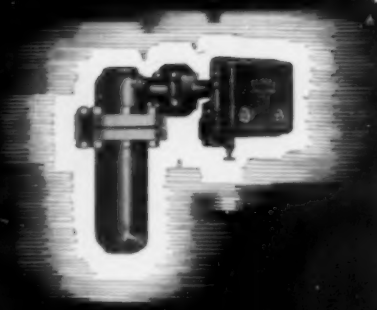

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Letters

Not Quite that Way . . .

To THE EDITOR: On page 1872 of the December issue, I am quoted as making the statement "There is no more appropriate place for industry to pool its resources."

This statement seems to have been taken out of context and does not accurately express my words. I was trying to convey the idea that "there is no more appropriate place for the petroleum refining industry to pool its knowledge and experience on matters pertaining to public safety and general public service in such fields as waste disposal and safe standards for refinery equipment."

E. B. MCCONNELL
Vice President, Refining
American Petroleum Institute, and
Vice President, Manufacturing
Standard Oil Co. (Ohio)
Cleveland, Ohio

Catching Lab Thieves

To THE EDITOR: . . . In regard to the article on our fractional analysis program ["Handcuff that Test Lab Thief!" November, pp. 1746-1748]: this program was started back prior to World War II and has been excellent as a police mechanism in letting various laboratories know when they have gotten "off the beam." I think you have done an excellent job in presenting to the petroleum industry the points developed in our program and I, personally, appreciate the emphasis you have given to certain aspects of these results . . .

One other thing was of interest to me concerning these last tests. None of the best ten laboratories or best ten procedures were methods other than low temperature fractionation. We found that infrared, spectrographic, etc., were good in some instances, but for a complete analysis were not among the best for giving accurate results.

At our Technical Committee meeting in Dallas in October, continued interest was shown in this program and we intend to circulate synthetic samples from time to time in the future . . .

CHARLES E. WEBBER
Technical Committee Chairman
Natural Gasoline Ass'n of America
422 Kennedy Bldg.
Tulsa 3, Okla.

• *Thanks, reader Webber, Southwestern Editor Dave Thornton will be glad you liked his writing job.*

Mass Spectrometry . . .
on a practical industrial basis

Two companion instruments. Types 21-610 and 21-620, now extend the speed and accuracy of mass spectrometric analysis from the laboratory out into the plant. Flexible and simplified, needing only 115 volts and a small supply of cooling water, the twin instruments are easily adaptable to process-stream monitoring, batch work, or leak detection.

For monitoring & controlling streams to mass 80 . . .

TYPE 21-610 is moderately priced and a truly general-purpose instrument. Although primarily designed for continuous petroleum and petrochemical stream analysis, it is also valuable as a production-line leak detector or laboratory analytical instrument. It has been used in applications ranging from on-the-spot acetylene-plant monitoring to hospital clinical tests on lungs.

For higher resolving power, readings to mass 150 . . .

TYPE 21-620 has the highest mass range of any instrument in its compact size range. Using the newly developed "Cycloidal Focusing" principle for analysis, it goes beyond the 21-610 for accurate readings from mass 2 to mass 150. Medical laboratories, petro-chemical plants and general research organizations will all find it an ideal answer to their analytical problems.

Modifications . . . accessories

The 21-610 may be converted to a 21-620 whenever the latter's greater resolving power is needed. The work is accomplished by a CEC Field Service Engineer without return of the instrument to the factory. Involving primarily the exchange of some components and the addition of certain others, the conversion is made reasonably and quickly.

An extensive accessory line greatly broadens the utility of both the 21-610 and 21-620. Automatic peak selectors scan as many as six mass numbers on a repetitive cycle; sampling probes and magnet shunts make either instrument a practical production-line leak detector; batch-sample inlet systems and continuous-chart recorders (left) may be mounted directly on the instruments.

How industrial mass spectrometry can be used in *your* business is explained in Bulletin CEC 1824A-X13. Send for your copy.

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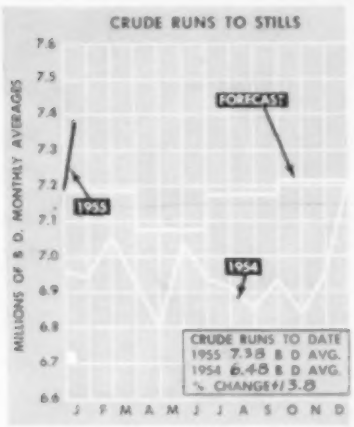
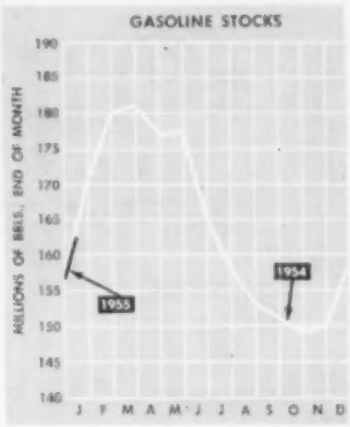


1955 figures to Jan. 14



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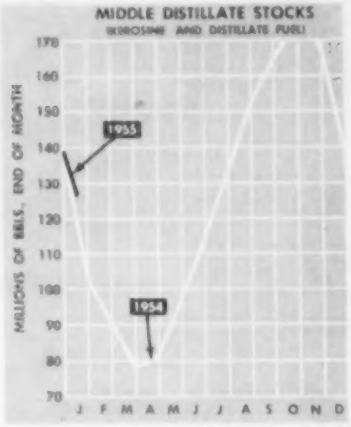


1955 figures to Jan. 14

Heating Oil Stocks Continue Ample

While demand for middle distillate products (distillate fuel and kerosine) in December was nearly 10% larger than in December, 1953, increased runs to stills and higher product yields have enabled refiners to maintain a sufficient inventory cushion against coming heating oil needs, unless the late winter is unusually severe.

The East Coast and California districts are the only ones where total distillate inventories are much under a year ago. East District stocks, Jan. 14, were 1,196,000 bbls. less than Jan. 15, 1954. However, in the Louisiana and Gulf Coast districts, which supply the east with part of its heating oil needs, inventories Jan. 14 were 747,000 bbls. higher than on the comparable date in 1954.

OUTLOOK: Crude runs may have to be stepped down, but good gasoline demand will brake the seasonal inventory build-up.

In the Ind.-Ill.-Ky district, total stocks of 25,362,000 bbls. on Jan. 14 were 2,292,000 bbls. (9.9%) larger than the year before. Inventories in Okla.-Kan.-Mo. were 12,397,000 bbls., (14.8%) larger.

Strong demand for gasoline in December held back the start of the normal seasonal buildup of these inventories, and the U.S. total Jan. 14 was 1,362,000 bbls. (0.8%) less than the comparable date in 1954. The Military Authorities are now calling for jet fuel requirements, for the second and third quarters, of 32,000,000 bbls., some 70% of which is gasoline. This is helping the market stability of light oils.

East Coast gasoline stocks Jan. 14 were 3,068,000 bbls. (8.7%) less than on Jan. 15, 1954. This was partly balanced by an increase in Louisiana and Gulf Coast inventories of 2,439,000 bbls. The Ind.-Ill.-Ky. district had 2,021,000 bbls. more in tanks.

After having held their operations down during a good part of 1954, U.S. refiners, for the 4 weeks ending Jan. 14, ran a daily average of 7,336,000 bbl. daily of crude oil to their stills, nearly 4.3% greater than in the comparable weeks in 1954, and about 146,000 b/d over the average daily volume forecast as required for the first quarter. The step-up in runs was mostly in the Gulf Coast and Okla.-Kan.-Mo. areas.

JANUARY KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbls. at end of month)

	Jan.1955*	Dec.1954	Jan.1954
CRUDE OIL			
U. S. Production	6.631	6.357	6.240
Imports	.619	.624	.618
U. S. Stocks	256.519	262.043	270.811
Runs to Stills	7.379	7.203	6.947
GASOLINE			
Refinery Output	3.584	3.536	3.354
Refinery Demand	3.316	3.427	2.985
Primary Stocks	162.198	157.228	171.704
MIDDLE DISTILLATES			
Refinery Output	2.152	2.027	1.857
Refinery Demand	2.947	2.988	3.075
Primary Stocks	127.788	138.912	103.057
RESIDUALS			
Refinery Output	1.258	1.138	1.271
Imports	.593	.504	.490
Total Supply	1.851	1.642	1.761
Refinery Demand	1.908	1.755	1.835
Primary Stocks	50.566	51.361	47.474

* Through Jan. 14.

PRODUCT AND CRUDE PRICES

Products—¢ gal., weighted average prices in principal refinery markets
Crudes—$/bbl., principal fields
Source—Platt's Oilgram Price Service

	Jan.1955*	Dec.1954	Jan.1954
Gasoline	11.36	11.30	12.10
Distillate Fuel Oil	9.22	9.07	10.37
Kerosine	10.71	10.58	9.03
Residuals	4.18	4.08	4.24
Above 4 Products	8.85	8.76	9.20
Lube Oils	16.46	16.46	17.14
Crude	2.81	2.81	2.82

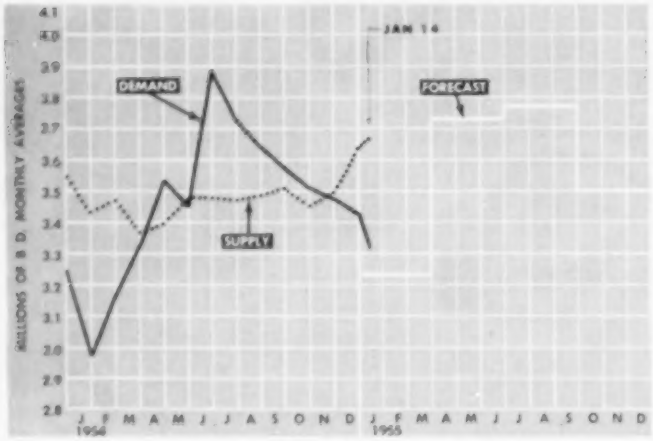
REFINERY YIELDS

% on Crude Runs to Stills

	Jan.1955*	Dec.1954	Jan.1954
Gasoline	44.1	44.5	43.8
Kerosine	5.5	5.2	5.6
Distillate	23.7	22.9	21.1
Residuals	17.0	15.8	18.3

SOURCE of DATA (except prices): Nov., Dec. and Jan., API weekly reports; earlier months, Bureau of Mines

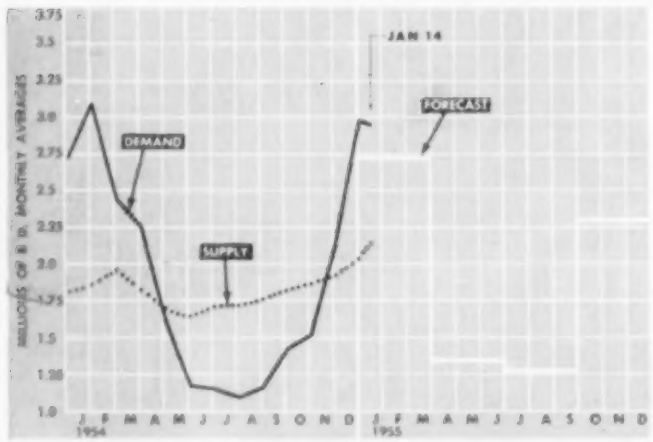
Motor Fuel Supply Trends Upward



MOTOR FUELS

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
Dec. '54	3.196	.450	3.646
Dec. '53	3.135	.417	3.552
Change	+.061	+.033	+.094
% Change	+1.9	+7.9	+2.6
DEMAND (including Exports) (Millions of b/d)			
Dec. '54			3.427
Dec. '53			3.253
Change			+.174
% Change			+5.3
TOTAL SUPPLY (Millions of bbls.)			
12 Mos. '54	1,114.799	155.000	1,269.799
12 Mos. '53	1,122.661	144.264	1,266.925
Change	−7.862	+10.736	+2.874
% Change	−0.7	+7.4	+0.2
TOTAL DEMAND (including Exports) (Millions of bbls.)			
12 Mos. '54			1,271.204
12 Mos. '53			1,244.249
Change			+26.955
% Change			+2.2

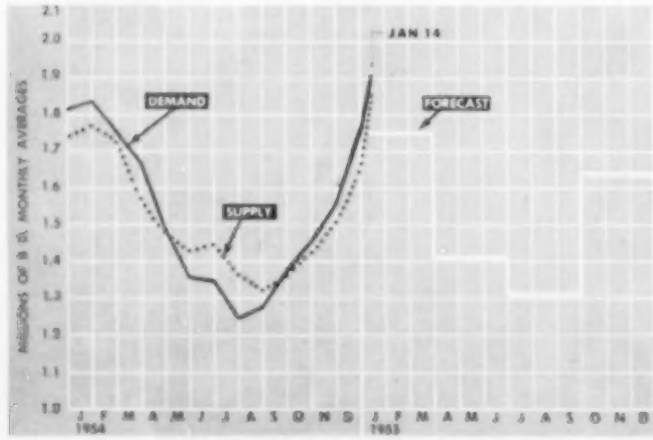
Distillate Demand Eases in Early January



MIDDLE DISTILLATES

	Kerosine	Dist. Fuel Oil	Total
PRODUCTION (Millions of b/d)			
Dec. '54	.376	1.651	2.027
Dec. '53	.362	1.432	1.794
Change	+.014	+.219	+.233
% Change	−3.8	+15.3	+13.0
DEMAND (including Exports) (Millions of b/d)			
Dec. '54	.586	2.402	2.988
Dec. '53	.587	2.139	2.726
Change	−.001	+.263	+.262
% Change	−0.2	+12.3	+9.6
TOTAL PRODUCTION (Millions of bbls.)			
12 Mos. '54	121.923	540.268	662.191
12 Mos. '53	123.200	528.111	651.311
Change	−1.277	+12.157	+10.880
% Change	−1.0	+2.3	+1.7
TOTAL DEMAND (including Exports) (Millions of bbls.)			
12 Mos. '54	122.380	545.680	668.060
12 Mos. '53	121.732	521.379	643.111
Change	+.648	+24.301	+24.949
% Change	+0.5	+4.7	+3.9

Residuals in Strong Seasonal Demand



RESIDUAL FUELS

	Refinery Output	Imports	Total
SUPPLY (Millions of b/d)			
Dec. '54	1.138	.504	1.642
Dec. '53	1.247	.487	1.734
Change	−.109	+.017	−.092
% Change	−8.7	+3.5	−5.3
DEMAND (including Exports) (Millions of b/d)			
Dec. '54			1.755
Dec. '53			1.809
Change			.054
% Change			−3.0
TOTAL PRODUCTION (Millions of bbls.)			
12 Mos. '54	415.101	131.752	546.853
12 Mos. '53	449.979	136.209	586.188
Change	−34.878	−4.457	−39.335
% Change	−7.8	−3.3	−6.7
TOTAL DEMAND (including Exports) (Millions of bbls.)			
12 Mos. '54			549.689
12 Mos. '53			591.141
Change			−41.452
% Change			−7.0

SOURCE OF DATA: Nov., Dec. and Jan. weekly reports; earlier months, Bureau of Mines

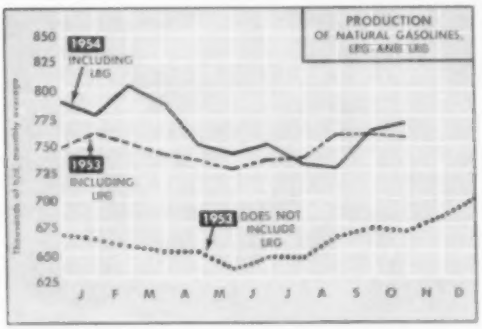
RUNS TO STILLS and DISTRIBUTION OF PRIMARY STOCKS BY U.S. REFINERY DISTRICTS

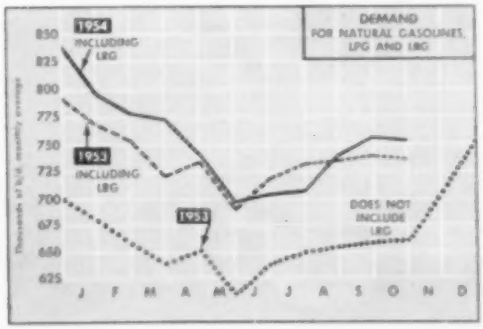
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) Jan.14 1955	Jan.15 1954	Change	% Change	GASOLINE STOCKS (Millions of bbls., on date shown) Jan.14 1955	Jan.15 1954	Change	% Change	RESIDUAL STOCKS (Millions of bbls., on date shown) Jan.14 1955	Jan.15 1954	Change	% Change
East Coast	1.070	1.039	+.031	+ 3.0	32.169	35.237	—3.068	—8.7	8.903	11.289	—2.386	—21.1
Gulf Coast	2.466	2.206	+.260	+11.8	34.888	32.449	+2.439	+7.5	5.549	7.856	—2.307	—29.4
Total Coastal	3.536	3.245	+.291	+ 9.0	67.057	67.686	— .629	—0.9	14.452	19.145	—4.693	—24.5
Appalachian	.185	.219	—.034	—15.5	6.999	6.471	+ .528	+8.2	.749	.996	— .247	—24.8
Ind.-Ill.-Ky.	1.365	1.296	+.069	+ 5.3	35.951	33.930	+2.021	+6.0	3.671	4.365	— .694	—15.9
Okla.-Kans.-Mo.	.690	.574	+.116	+20.2	15.953	17.651	—1.698	—9.6	1.208	1.097	+ .111	+10.1
Other Inland	.598	.568	+.030	+ 5.3	16.955	16.805	+ .150	+0.8	2.336	2.348	— .012	— 0.5
Total Inland	2.838	2.657	+.181	+ 6.8	75.858	74.857	+1.001	+1.3	7.964	8.806	— .842	— 9.6
Total East of Calif.	6.374	5.902	+.472	+ 8.0	142.915	142.543	+ .372	+0.3	22.416	27.951	—5.535	—19.8
California	.996	1.066	—.070	— 6.6	19.283	21.017	—1.734	—8.3	28.150	21.115	+7.035	+33.3
Total U.S.	7.370	6.968	+.402	+ 5.8	162.198	163.560	—1.362	—0.8	50.566	49.066	+1.500	+ 3.1

District	DISTILLATE FUEL OIL STOCKS (Millions of bbls., on date shown) Jan.14 1955	Jan.15 1954	Change	% Change	KEROSINE STOCKS (Millions of bbls., on date shown) Jan.14 1955	Jan.15 1954	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbls., on date shown) Jan.14 1955	Jan.15 1954	Change	% Change
East Coast	36.119	37.180	—1.061	— 2.9	11.559	11.694	— .135	— 1.2	47.678	48.874	—1.196	— 2.4
Gulf Coast	15.860	16.037	— .177	— 1.1	4.532	3.608	+ .924	+25.6	20.392	19.645	+ .747	+ 3.8
Total Coastal	51.979	53.217	—1.238	— 2.3	16.091	15.302	+ .789	+ 5.2	68.070	68.519	— .449	— 0.7
Appalachian	2.809	2.068	+ .741	+35.8	.971	1.097	— .126	—11.5	3.780	3.165	+ .615	+19.4
Ind.-Ill.-Ky.	18.075	16.545	+1.530	+ 9.3	7.287	6.525	+ .762	+11.7	25.362	23.070	+2.292	+ 9.9
Okla.-Kans.-Mo.	10.690	9.468	+1.222	+12.9	1.707	1.333	+ .374	+28.1	12.397	10.801	+1.596	+14.8
Other Inland	5.388	5.154	+ .234	+ 4.5	1.225	.840	+ .385	+45.8	6.613	5.994	+ .619	+10.3
Total Inland	36.962	33.235	+3.727	+11.2	11.190	9.795	+1.395	+14.2	48.152	43.030	+5.122	+11.9
Total East of Calif.	88.941	86.452	+2.489	+ 2.9	27.281	25.097	+2.184	+ 8.7	116.222	111.549	+4.673	+ 4.2
California	11.170	12.894	—1.724	—13.4	.396	.393	+ .003	+ 0.7	11.566	13.287	—1.721	—13.0
Total U.S.	100.111	99.346	+ .765	+ 0.7	27.677	25.490	+2.187	+ 8.6	127.788	124.836	+2.952	+ 2.4

Natural Gas and Refinery Gas Liquids





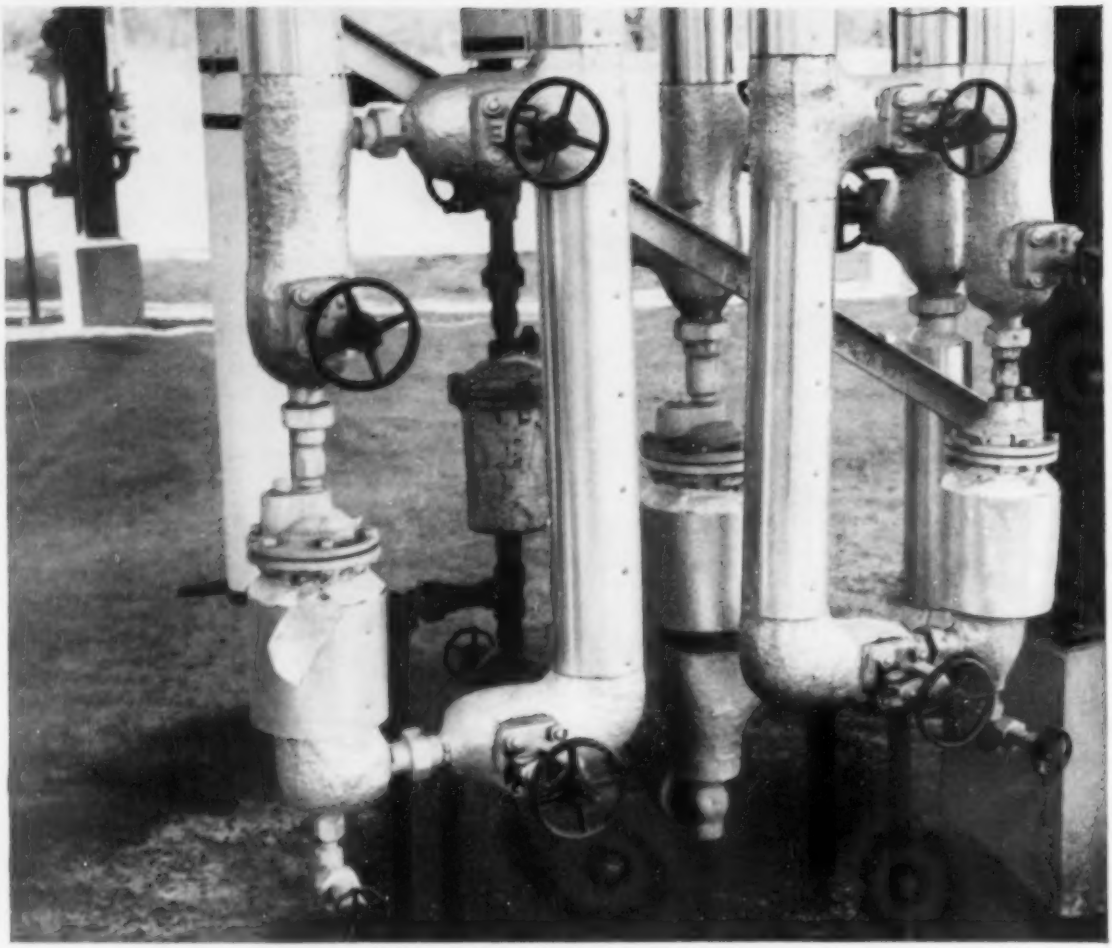
SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

CURRENT PRODUCTION (1000 b/d monthly average)	Oct. 1954	Sept. 1954	Oct. 1953
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	332	315	317
Natural Gasoline and Isopentane	274	273	262
Condensate	24	25	25
Finished Gasoline, Naphtha and Other	62	63	68
Total Natural Gasoline and Cycling Plant Production	692	676	672
Liquefied Refinery Gases	80	89	85
Total Marketable Gas Liquids	772	765	757
Lease Condensate	96	93	90
Total Natural Gas Liquids	868	858	847
CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	394	400	367
Natural Gasoline, Isopentane and Other	358	355	366
Total Current Demand	752	755	733

CUMULATIVE PRODUCTION (1000 bbls.)	Oct. 1954	Oct. 1953
LPG and LRG	124,573	120,445
Natural Gasoline, Isopentane and Other	107,098	106,955
Total Marketable Gas Liquids	231,671	227,400
CUMULATIVE DEMAND (1000 bbls.)		
LPG and LRG	118,779	115,321
Natural Gasoline, Isopentane and Other	107,176	107,231
Total Cumulative Demand	225,955	222,552

STOCKS (1000 bbls., end of month)	Oct. 1954	Sept. 1954	Oct. 1953
LPG and LRG	10,271	9,716	5,888
Natural Gasoline, Isopentane and Other	4,809	4,751	5,322
Total Stocks	15,080	14,467	11,210



Picture of Low Cost Steam Trapping . . .

The Armstrong steam traps pictured above are in a field processing plant in Oklahoma. It's a nice installation—traps neatly installed in bypasses, lines well insulated, blowdown valve below each trap. Obviously, no corners have been cut to save nickels. Then, what do we mean by "picture of *low cost* steam trapping." Simply this:

Low cost traps—the price tag doesn't read any lower, but, because of high capacity, you can usually select an Armstrong trap one size smaller than other makes.

Low cost installation — Armstrong offers a choice of either side inlet-side outlet or bottom inlet-top outlet traps in most sizes so that hook-ups can be made with a minimum of labor and fittings. All traps can be equipped with internal check valves, and the three smallest traps are available in integral strainer style. These optional built-in features mean lower installation costs.

Low cost maintenance—Armstrong traps last for long periods without repairs because the valves and seats are corrosion-resistant, file-hard chrome steel, ground and then lapped together; and all other working parts are corrosion-resistant stainless steel. Materials and workmanship are unconditionally guaranteed.

Low production costs—because Armstrong traps provide fast drainage and have large air handling capacity, they provide maximum output from steam heated units and give a bigger return on equipment investment. They save steam, too, through reduction of non-productive radiation losses and freedom from leakage. For *low cost* trapping it pays to specify "traps shall be Armstrong."

ARMSTRONG MACHINE WORKS
826 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

ASK FOR CATALOG

Complete selection, installation, maintenance and trap data in the useful 44-page Steam Trap Book. Call your local Armstrong Representative or write Armstrong Machine Works.

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

February ★ One of a Series of Interest to the Petroleum Industry ★ 1955

NEW BOOKLET

to help you explain surface ignition to non-technical people

Outside of a small group of specialized engineers, few people understand surface ignition.

What causes it? How does it manifest itself? What are its harmful effects? And what can you do to overcome the problem?

The chances are you are frequently asked these questions, by outsiders and executives of your own company. But accurate, clear-cut, easy-to-understand answers are often hard to come by.

So to help you promote a better and wider understanding of surface ignition, and the problems surrounding it, Du Pont has prepared an eight-page booklet entitled "Combustion and Surface Ignition." It is profusely illustrated in full color. And it explains quickly and understandably the phenomenon of surface ignition and the technical terms used to describe it.

The booklet is now available to fuel engineers for limited distribution. Any of our regional offices will be glad to supply you with a sample copy and information on obtaining additional copies.

Unique Dust-Injection Engine for Studying Surface Ignition

In order to study the erratic process of surface ignition under controlled conditions, engineers at the Du Pont Petroleum Laboratory have developed a novel technique, called the "aspirated deposit surface ignition test."

In this modified C.O.T. engine with electronic counter, engineers can create controlled surface ignition by introducing a small amount of powdered combustion chamber deposit.

The technique uses a single-cylinder engine, modified to permit the introduction of a small amount of combustion chamber deposit into the intake port. This *dust-injection* engine uses a fuel susceptible to surface ignition, containing benzene or diisobutylene. To isolate chemical reactions associated with surface ignition, the engine operates under typical non-knocking conditions.

Pin-pointing ping

The number of surface ignitions caused by the introduction of the combustion chamber "dust" is taken as the measure of surface ignition harm of deposits.

Surface ignition is detected by an internal type of pickup, mounted in the engine cylinder. The number of surface ignitions is counted by a four-decade counting unit actuated by a signal from the pickup.

Findings from this unique test method reveal the relationship between the composition of combustion chamber deposits and their contribution to surface ignition.

A New Company With Established Services For Your Canadian Operations

DU PONT COMPANY OF CANADA LIMITED, and its Petroleum Chemicals Division, offer a wide range of marketing, technical and safety services to all oil companies operating north of the border. If you are considering expansion in or to Canada, these services can have an important bearing on your plans.

THESE THREE recently completed forecasts deal with the Canadian market exclusively. They cover gasoline, passenger cars, commercial vehicles and farm tractors—for the period from 1954 to 1960. They are offered as an oil industry service by Du Pont of Canada.

Suppose, for example, you want to build a new refinery in Alberta. You want to employ local workers wherever possible. But training local blending plant personnel in the safe handling of tetraethyl lead presents a real problem. To transport a special training crew from the States is likely to prove difficult and costly.

Here is a typical case where a Du Pont of Canada representative can be extreme-

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Du Pont of Canada*

ly valuable to you. And in addition to helping with employee training and safety projects, the Canadian representatives are prepared to offer many specialized services in connection with the design, site selection, construction, and operation of your blending plant.

Who, what, where? . . .

Du Pont of Canada is a separate, individual company . . . one of two companies recently formed out of the former Canadian Industries Limited.

Its Petroleum Chemicals Division has its headquarters in Toronto, with branch offices in Montreal and Calgary. It handles the complete Du Pont line of lube oil, fuel oil and grease additives, as well as gasoline dyes, antioxidants, Metal Deactivator and tetraethyl lead.

The Canadian sales-service representatives have had the same extensive technical training and oil industry experience as their stateside colleagues. And the services they offer are exactly parallel, too.

Developing a new market

With all forecasts pointing to a tremendous expansion in the Canadian economy during the next few decades, it can be expected that petroleum products marketing, as well as production and refining, will play an increasingly important role in Canadian Oil Industry activities.

To help you make the most of this growth potential, a wide range of movies, booklets, special presentations and other sales promotion aids are available to Canadian marketers through Du Pont of Canada. And this service also includes such industry-wide public relations programs as the well-known Du Pont "Magic Barrel."

Laboratory services, too

Although the five Du Pont Petroleum Chemicals Division regional laboratories are located in the United States, the services of these unique laboratories are available to all Canadian oil companies.

What's more, the Petroleum Chemicals Division of Du Pont of Canada is backed up by the basic research activities of the Du Pont Petroleum Laboratory and Experimental Station in Wilmington.

So if you are now operating in Cana-

Continued—bottom of next column

da or plan to in the future, be sure to keep in touch with one of the Du Pont of Canada Petroleum Chemicals Division representatives. He can be a very helpful man to know.

CANADIAN MANAGER

MILTON A. DEWEY is manager of the Petroleum Chemicals Division, Du Pont Company of Canada Limited.

After graduating from the University of Illinois with a B.S. degree in Chemical Engineering, he joined the Mid-Continent Petroleum Corporation in Tulsa, Oklahoma as a refinery engineer. Mr. Dewey left Mid-Continent to accept a research fellowship at Pennsylvania State College—working in the Petroleum Refining Laboratory, sponsored by the Pennsylvania Grade Crude Oil Association.

He then joined the staff of the Gulf Research Corporation in Pittsburgh and later became head of this company's Analytical Laboratory, in charge of research on turbine and electrical oil additives.

Mr. Dewey came to Du Pont in 1937. One of his first jobs at Du Pont was as liaison between the oil company research laboratories and various Du Pont laboratories. In this capacity, product development work was one of his chief responsibilities.

MILTON A. DEWEY

In 1950, he was transferred to Canadian Industries Limited, in charge of petroleum chemicals sales. He continued in this assignment until Du Pont of Canada was formed last July, at which time he was appointed to his present position.

Sales Opportunity for Lube Oils With Low-Duty Detergents

For 48% of American passenger cars, the average trip is less than 4 miles. For 75%, it is less than 10 miles. For only 15% it is 16 miles or over. And for all city busses, taxis and delivery trucks, more than 90% of their total operation is local stop-and-go traffic.

And these low-power, low-temperature operating conditions lead to excessive build-ups of engine sludge.

But these adverse driving conditions do not necessarily represent an obstacle to you. You can turn them into a real sales opportunity for your brand of motor oil. How? . . .

By adding one of the new polymeric lube oil additives to your motor oil (Du Pont Lube Oil Additives 564 and 565).

Being outstanding detergents and viscosity-index improvers, these double-action additives are exceptionally effective and economical for retarding sludge formations caused by low-power, low-temperature driving conditions. And being ashless, they leave no metallic deposit.

For more details on these new additives, contact any of our regional offices listed below.

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. . . through Chemistry

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IN CANADA: Du Pont Company of Canada Limited—Petroleum Chemicals Division, 80 Richmond Street West, Toronto 1, Ontario
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A-8712

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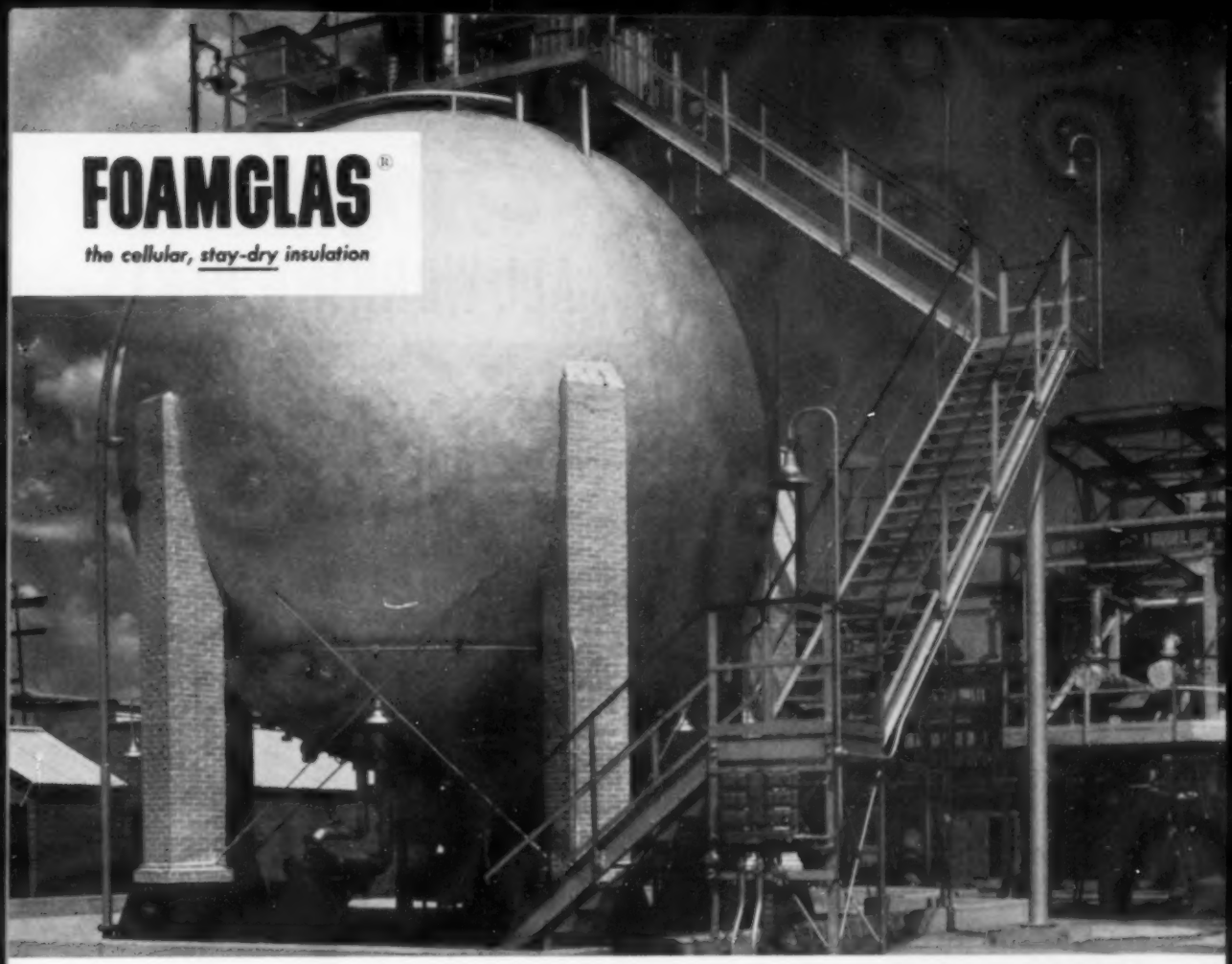


Insulation Contractor: Combustion Equipment & Insulation Co., Cleveland, Ohio

SOHIO gets efficient desalting because . . .

Spillage-proof FOAMGLAS insulation stays effective to hold precise temperature

Efficient electric desalting to remove salts and other impurities from crude charging stocks demands precise temperature control throughout the process. The influent temperature (180° F to 220° F depending on viscosity of crude) must be held constant until effluence. Since there's no exchange of heat inside the sphere, it must be insulated very effectively.

For six years Standard Oil Company (Ohio) has maintained peak desalting efficiency by insulating their spheres in Cleveland, Lima and Toledo with FOAMGLAS. This unique cellular glass insulation benefits SOHIO three ways:

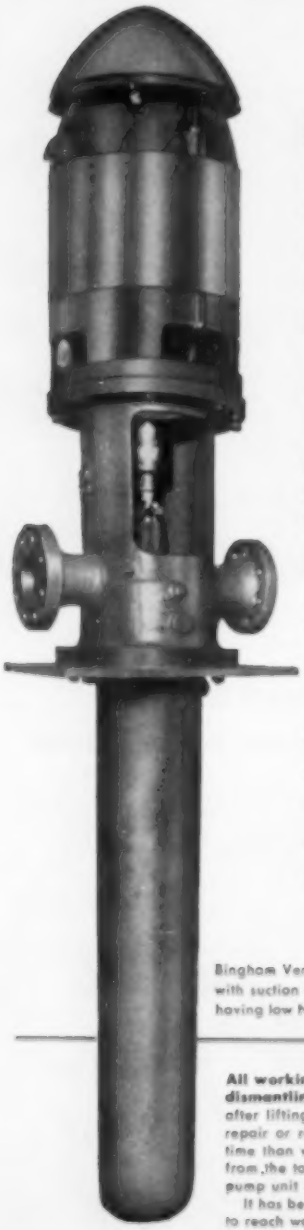
1. **Spillage-proof,** moisture-proof FOAMGLAS retains its insulating value . . . avoids fire hazard.
2. **Easy-to-apply** FOAMGLAS blocks are lightweight but very strong, readily applied to sphere, eliminating insulation supports.
3. **Effective insulation** holds temperature required for electric field to break continuously the water and oil emulsion. It also prevents temperature drop near vessel wall . . . avoids thermal currents which would interfere with process.

You'll benefit too by using this unique insulation. For more facts please write for booklets on FOAMGLAS for piping or tanks and equipment.

Pittsburgh Corning Corporation
Dept. PP-25, One Gateway Center
Pittsburgh 22, Pennsylvania
In Canada: 57 Bloor St. W., Toronto, Ontario

2" thick FOAMGLAS blocks cut to 12 x 12 size were laid diamond shape on SOHIO'S desalter sphere in Toledo. Two Nelson studs were welded through each block and secured with recessed Tinnerman speed clips. After asphalt cutback (Insulmastic 4010)—glass fabric—cutback application, the surface was finished with an asphalt base aluminum paint.

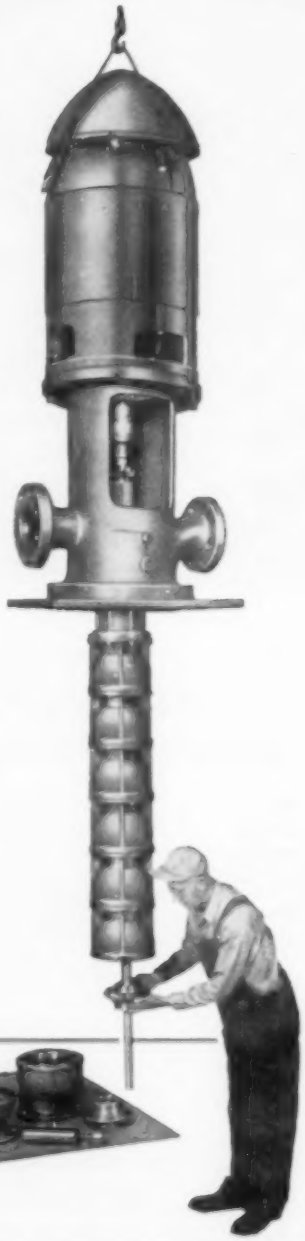
NEW! Bingham ALL WORKING PARTS



Besides bottom dismantling, which in itself greatly reduces maintenance time when attention is required, this new Bingham pump incorporates advanced design features which minimize maintenance, reducing the need for periodic inspection.

For example, all intermediate bearings (supplied of appropriate material for different pumpages) are forced-lubricated by the pumpage. Diagram at right shows this feature and, in addition, shows how bottom bearing is lubricated even if the pump runs dry for short periods. This *dependable* lubrication greatly prolongs the life of bearings, which in conventional pumps are frequently the cause of maintenance shutdowns.

Wherever it has been installed, the new Bingham VCP Pump has given trouble-free service—plus unsurpassed smooth operation with no vibration. Available for any capacity or head. Write your nearest Bingham office for additional information.



Bingham Vertical VCP assembled with suction well for installations having low NPSH conditions.

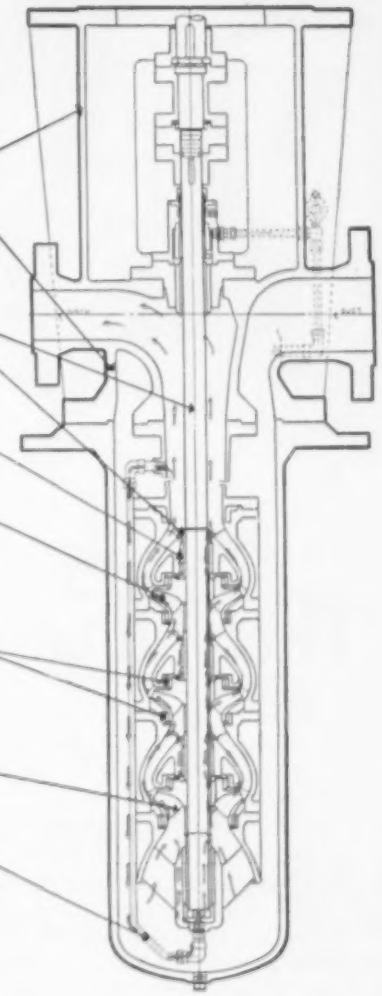
All working parts of pump easily accessible with bottom dismantling. One man can service the Bingham VCP Pump after lifting pump from well. By dismantling from the bottom, repair or replacement of any part can be made in much less time than with conventional pumps (where dismantling begins from the top, necessitating removal of driver and head before pump unit is accessible).

It has been estimated by various operators that time required to reach working parts has been reduced as much as 50%.

VCP VERTICAL PUMP FOR LOW NPSH
ACCESSIBLE WITH BOTTOM DISMANTLING

ONLY *Bingham* OFFERS ALL THESE BENEFITS:

1. Heavy-duty steel suction and discharge head rigidly built to eliminate vibration caused by drivers.
2. Shaft is maximum diameter throughout.
3. Shafts are equipped with renewable 11-13 chrome, hardened, ground and polished sleeves at each bearing.
4. Bearings are of the appropriate material for the different pumpages.
5. Maximum head per stage and maximum efficiency for a given capacity range.
6. Front and back wearing rings on enclosed type impellers permit a one-stage pressure drop over each bearing for lubrication purposes.
7. Wear rings reduce thrust of rotating element, permitting use of standard motors.
8. Maximum eye area of bottom impeller for lowest possible NPSH.
9. Bottom bearing lubricated by pumpage taken from the discharge column, which, together with connecting pipe, acts as a reservoir for bearing lubrication in event pump operates "dry" for short periods.



Bingham SINCE 1921 — DOUBLE VOLUTE PUMPS — RADIAL BALANCE

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Factories: Portland, Ore. • Vancouver, B.C., Canada

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BETZ, *A Great Name In Water Conditioning*

They all work for you!

It takes the combined ability and experience of many people to engineer effective water conditioning.

Few plants, however, can afford to maintain or establish an internal staff capable of supplying the constant flow of engineering knowledge, the diversification of thinking, the thousands of creative and supervisory man-hours that are necessary to the engineering, planning, and control of an effective water conditioning program.

By assigning the responsibility for result-getting water conditioning in your plant to the Betz Organization, you gain immediately the services of field, staff, and consulting engineers, researchers, chemists, and production personnel . . . *plus* the basic objectivity of an "outside" organization providing individual attention to your individual problems.

What's more, the services of these team specialists are available to you *without actually putting them on your payroll!*

Whether your problem requires boiler or cooling water conditioning, Betz completely-integrated service brings into play techniques, methods, and engineering that can make all the difference in *results*.

A Betz District Engineer, one of the many important members of the Betz service "team", will be happy to give you the details of our result-getting service. Why not call him in *today?*

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

(To obtain more data on advertised products see page 264)

NATIONAL LEAD PRODUCTS

FOR THE

CHEMICAL INDUSTRY

rely on LEAD to resist corrosion

Take a tip from the "Dutch Boy"

Send for this *FREE* 60-page book on corrosion resistant Lead products

Here, under one cover, you'll find information that may be valuable to you in solving corrosion problems.

The booklet contains sections on "Choosing Corrosion Resistant Materials", "Chemical Handling Capabilities of Lead", "Lead and Lead Lined Products", etc. It contains a series of graphs showing lead's corrosion resistance to various corrosive solutions. It gives you the data you want in making decisions on the specification and purchase of chemical handling equipment.

To get your copy simply fill in this coupon and mail it to the nearest Branch Office.

National Lead Company: New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Limited).

NATIONAL LEAD COMPANY

Please mail me, without obligation, a copy of your book, "National Lead Products for the Chemical Industry." I would also like any special information you may have on the use of lead for.....

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SHOWING FOR THE FIRST TIME - - -

A New Addition to the Dempster-Dumpster System of Low Cost Bulk Materials Handling

Now you can have either of two types of Dempster-Dumpsters in the fastest, most efficient and lowest cost method of bulk materials handling ever devised.

IN THIS MODERN, low cost system, one truck-mounted Dempster-Dumpster picks up, hauls and empties, or sets down intact, one loaded detachable Dempster-Dumpster Container after another, regardless of design or size, handling bulk materials of practically every description.

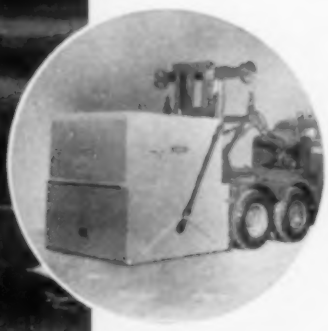
The new Dempster-Dumpster Type DTLF offers several desirable features along with all the economies provided by the Type LFW. These features include: (1) Improved load distribution with container carried in more forward position between wheel centers. (2) Extreme high dumping in cases where it is desired. (3) Vertical pick up of loaded container. (4) Container, loaded or empty, is always in horizontal plane in carrying position. Automatic locking device for positive rigidness of container while in carrying position is, of course, provided.

TREMENDOUS SAVINGS WITH THE DEMPSTER-DUMPSTER SYSTEM HAVE BEEN PROVED BEYOND QUESTION.

One truck-mounted Dempster-Dumpster, operated by only one man, the driver, serves scores of containers of various capacities up to three times greater than the average dump truck. You eliminate trucks standing idle . . . eliminate re-handling of materials . . . eliminate loading crews. You increase efficiency, sanitation and good plant-keeping.

Containers range from 2 to 21 cu. yds. capacity for use with recommended type Dempster-Dumpsters. Each container is designed to suit the materials to be handled—be they trash, rubbish, liquids, dust, bulky, light or heavy. Many leading plants, in almost every type of industry, have found it indispensable after installation. Its proved savings alone justifies an investigation of its potential value in your plant now. Write to us today for complete information. Manufactured and sold exclusively by Dempster Brothers, Inc.

The photo at left illustrates the amazing ability of the Type DTLF Dempster-Dumpster for high dumping. The three photos below show the Pick Up, Haul and Dumping action, hydraulically controlled from cab.

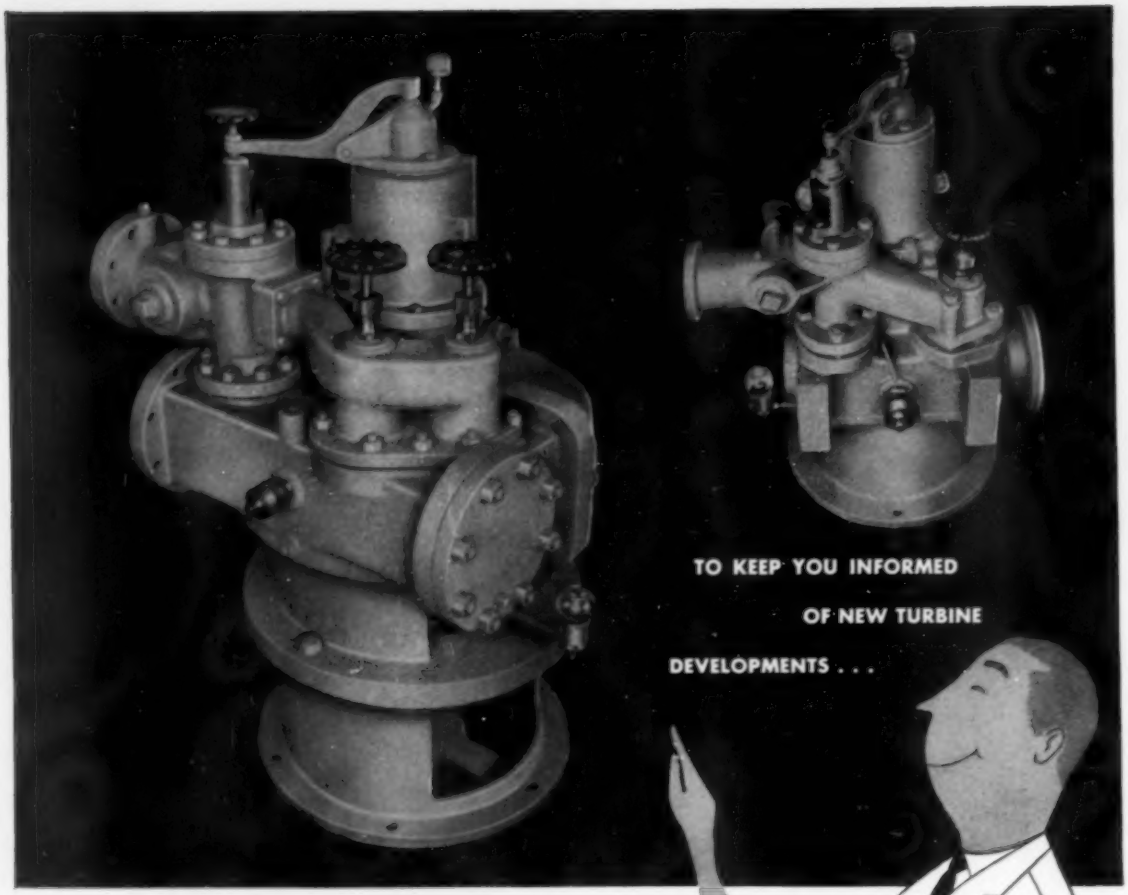


DEMPSTER

Photo above shows the new Dempster-Dumpster Type DTLF dumping 8 cu. yds. of rubbish. At right you see the Type LFW with load in carrying position. Dempster-Dumpsters are available in capacities capable of handling up to 38,000 pound payloads.

One Truck-Mounted
Dempster-Dumpster Handles Scores
of Containers . . . All Designs . . . All Sizes

BROTHERS 525 Dempster Building, Knoxville 17, Tennessee



Here are a few of the many improved features which help make the new Dean Hill Vertical Turbines your best power-package buy:

1. **MORE POWER**—An added steam nozzle for Models DH-10V (new in vertical line) and DH-20V increased power *100%* over former one-nozzle counterparts. The DH-30V now has three steam nozzles and 50% more power.
2. **BETTER PERFORMANCE**—Two hand valves improve regulation of steam rate at reduced load. Improved packing boxes check steam pressure leakage and permit higher back pressures.
3. **LONGER SERVICE**—*Double-row* ball bearing has greater thrust capacity. Overlapping labyrinth slinger on lower bearing prevents moisture seepage.
4. **POSITIVE SAFETY**—Improved emergency trip mechanism has cylindrical guide to maintain alignment of trip valve stem in all positions.

MORE DETAILS?

You will want to study the other improvements in the DH Line . . . improvements made to increase the useful life and efficiency of the turbine without sacrificing the compactness and simplicity of design. Write now for our new Catalog No. 500, which includes full details on both Vertical and Horizontal DH Turbines.

DEAN DH HILL PUMP COMPANY

Pump and Turbine Engineers Since 1893

Indianapolis 7, Indiana

Sales Offices In: Chicago, New York, San Francisco, Boston, Cincinnati, Denver, Albuquerque, El Paso, Salt Lake City, New Orleans, Philadelphia, Tulsa, Los Angeles, Pittsburgh, Houston, Dallas, St. Paul, Toledo, Cleveland, Grand Rapids, Birmingham, Ala., Louisville, Memphis, Richmond, Mexico City, Montreal, Reading, Pa., The Hague, Washington, Charlotte, Casper, Wyo., Knoxville.

YORK Technical Literature

1 Yorkmesh DeMisters, Entrainment Separators and Mist Eliminators

A bulletin describing the clean separation between liquid and vapor in all types of process vessels by means of Yorkmesh DeMisters. Information covers construction, types, applications, engineering data and installation instructions for improving the performance of vacuum towers, distillation equipment, gas absorbers, flash drums, knock-out drums, scrubbers, and evaporators through the use of wire mesh entrainment separators and mist eliminators.

2 Solvent Extraction

A bulletin presenting principles of operation, typical applications and engineering data on standard laboratory and pilot plant York-Scheibel multi-stage extraction units which are highly efficient and practical for both simple counter current and fractional liquid extraction.

3 "Performance of Wire Mesh DeMisters" by: Otto H. York

Reprint of paper presented before A. I. Ch. E. describing the performance of wire mesh demisters. Presents case histories from the chemical, petroleum and petrochemical industries which show how wire mesh demisters, are being used to eliminate overhead losses and increase the quality of the overhead product, while permitting operation at vapor velocities which would otherwise be excessive.

4 Bulletin 16 "Clean Separation with Yorkmesh DeMisters"

Bulletin 16 provides a detailed technical explanation with photos and schematic diagrams of the construction, types and applications of wire mesh demisters used to insure clean separation between liquids and vapors in vacuum towers, distillation equipment, gas absorbers, scrubbers, evaporators, knock-out drums and steam drums. Also included in this bulletin is a discussion of the York-Scheibel liquid-liquid Multi-Stage extraction column which is highly efficient and practical for both simple counter current and fractional liquid extraction.

5 Case Study 1001 "Entrainment Elimination Gives 31% Capacity Increase"

Detail case study showing how the installation of a stainless steel wire mesh section in an asphalt vacuum still at the Sinclair, Wyoming refinery of Sinclair Refining Company stopped entrainment and increased capacity. The account describes how the wire mesh installation was made and includes complete data on operating conditions before and after installation.

6 Case Study 1002 "Catalyst Poisoning Reduced 90%"

Case Study 1002 shows how the installation of a wire mesh demister pad in a vacuum tower supplying a substantial portion of the charge stock to several cracking units at General Petroleum Corp.'s Torrence refinery resulted in a 90% reduction in catalyst poisoning. Also included is a detailed description of tower operating conditions, the method of wiremesh installation and a table comparing metals content before and after the installation was made.

7 Case Study 1003 "Yorkmesh DeMister Eliminates Caustic Spray"

This case story contains reproductions of the initial correspondence, recommendations, order and service history exchanged through the mails by Otto H. York Co., Inc. and process engineers at a chemical plant troubled with a serious air pollution problem caused by the fine caustic spray rising from the open top of a scrubbing tower when operated at a steam rate of 3000#/hr. The correspondence reveals how a 6" demister section recommended by York completely eliminated the objectionable caustic spray.

8 Case Study 1004 "Vacuum Tower Capacity Increased 35%"

This case history shows how the installation of stainless steel wire mesh sections in two vacuum asphalt towers at Marcus Hook, Pa., refinery of Sinclair Refining Co. increased feed capacity 30-35% while maintaining gas-oil quality. Included in the account is a complete description of vacuum tower operation, a table of operating conditions and a comparison of operations before and after the demister installation. Also included is a diagram of the vacuum tower indicating the position of the wire mesh filter and the relative positions of the internal elements.

9 Case Studies 1005 and 1006 "Yorkmesh DeMisters Cut Compressor Maintenance"

Two case history accounts tell, respectively, how a monel wire mesh demister was installed in the compressor suction drum of a deasphalting unit at a Gulf Coast Refinery to reduce high maintenance costs on propane compressors; and how installation of a monel wire mesh demister pad in the compressor suction line of the catalytic cracking unit at a Midwest Refinery completely stopped the excessive maintenance which resulted from dilution of valve lubricants by liquids entrained in the gas stream.

10 "Calculation of Liquid-Liquid Extraction Processes" by: Edward G. Scheibel, Hoffmann-LaRoche, Inc.

Twelve page illustrated booklet with diagrams, charts and graphs, primarily concerned with coordinating existing information and presenting the simplest and most direct methods for the study and design of liquid-liquid extraction processes.

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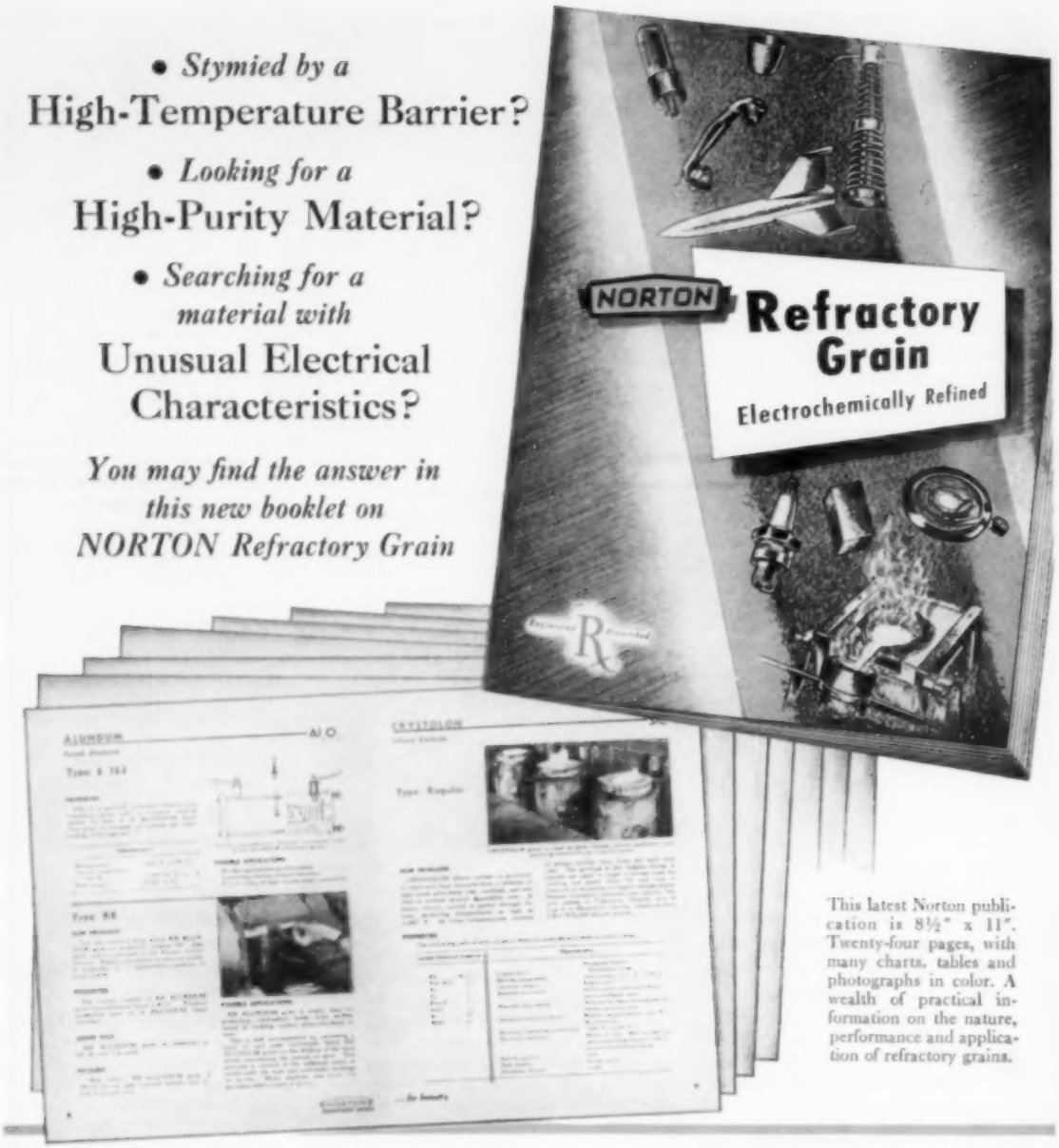
Unusual Electrical Characteristics?

You may find the answer in this new booklet on NORTON Refractory Grain



This latest Norton publication is 8½" x 11". Twenty-four pages, with many charts, tables and photographs in color. A wealth of practical information on the nature, performance and application of refractory grains.

IF you're concerned with industrial processing involving temperatures ranging upwards to 4000°C and materials to contain your inferno — if you're looking for a high-purity material such as high-purity fused alumina for coating electronic heater filaments — if you're searching for a material with unusual electrical characteristics such as E 179 CRYSTOLON® Silicon Carbide for lightning arrestors — one of the many types of Norton Refractory Grain available may solve your problem.

This new booklet describes in detail Norton Refractory Grain — produced and purified in electric arc and high temperature resistance furnaces — which is helping industry to improve existing products and processes and to create new ones.

It's a valuable reference book with up-to-the-minute information on the chemical and physical characteristics of such materials as CRYSTOLON® Silicon Carbide, ALUNDUM® Aluminum Oxide, MAGNORITE® Magnesium Oxide, Fused Zirconia and Boron Carbide. In it you'll find data on how these materials are produced; their behavior under varying conditions; available grain size and applications.

These electrochemically refined materials may be just what you've been looking for to solve your problem. Write today for your free copy of "Norton Refractory Grain." NORTON COMPANY, Refractories Division, 261 New Bond Street, Worcester 6, Mass.

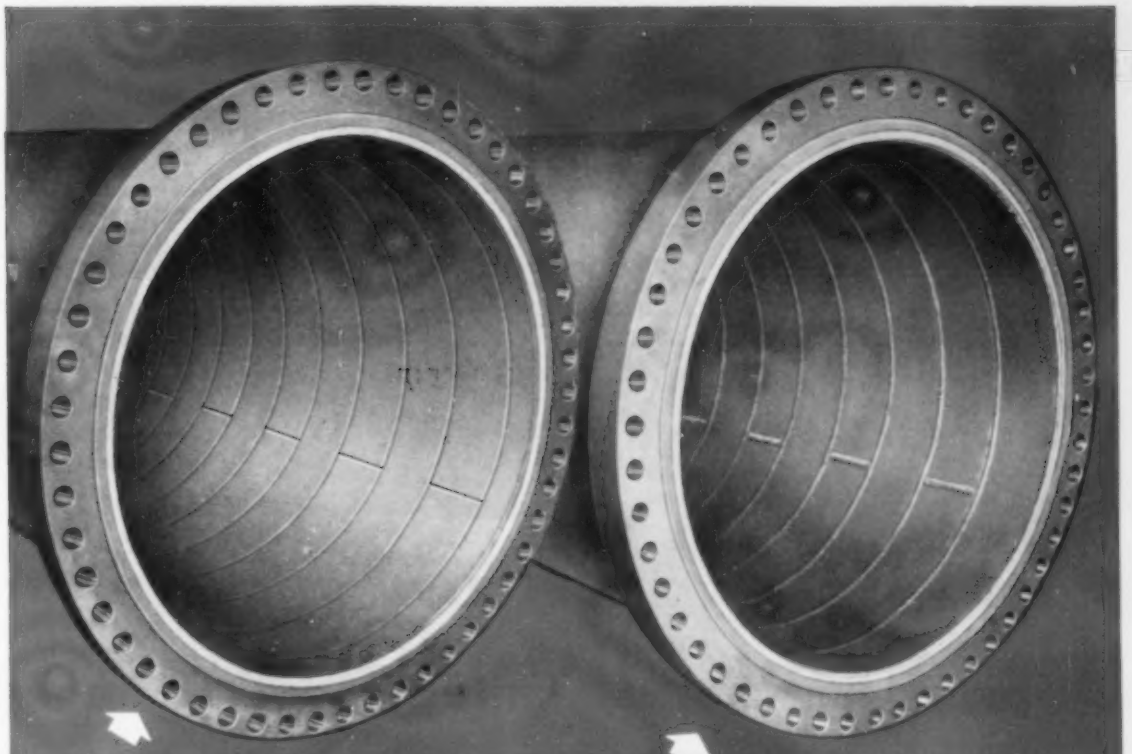
NORTON

REFRACTORIES

Engineered... Rx ... Prescribed

Making better products... to make your products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



Lining Fitted—Before Welding *Vessel Completely Lined—After Welding*

For Special *Lined* Processing Vessels

Come to STRUTHERS WELLS

LINING processing vessels of all kinds for chemical plants and refineries is another service in which Struthers Wells specializes. Years of engineering experience and extensive fabricating facilities enable us to build lined vessels that meet all codes and requirements.

The vessel illustrated is Inconel-lined, 36" I.D. x 43' high. Working pressure is 600 lbs. Lining is welded to outer wall to become an integral part of the processing vessel.

Vessels can be furnished lined with titanium, stainless steel, nickel, silver, hastelloy and other weldable metals to suit your applications.

Struthers Wells

STRUTHERS WELLS CORPORATION

TITUSVILLE, PA.

Plants at Titusville, Pa. and Warren, Pa.

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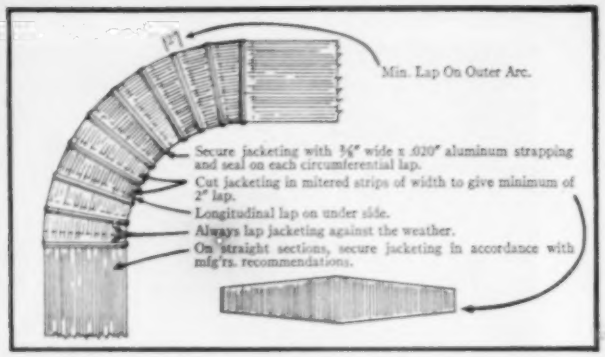

Min. Lap On Outer Arc.
Secure jacketing with ¾" wide x .020" aluminum strapping and seal on each circumferential lap.
Cut jacketing in mitered strips of width to give minimum of 2" lap.
Longitudinal lap on under side.
Always lap jacketing against the weather.
On straight sections, secure jacketing in accordance with mfg'rs. recommendations.

New method of applying aluminum jacketing over pipe bends with a radius of 5 diameters or more is shown above.

Cutaway view shows how jacketing goes on right over the insulation. Tests show Childers is the lowest cost of any permanent metal jacketing that is available today.

Only pliers and pocket knife needed to apply easy-to-handle Childers Aluminum Jacketing

How To Apply:

Best method of applying jacketing is with aluminum strapping and seals. Other method is to use sheet metal screws.

Aluminum strapping can be pulled tight enough with just pliers. Lugs are then bent over and fastening is complete.

Eastern States Petroleum's two-man crew covers insulated lines, even L's and bends—using light-weight, weatherproof aluminum jacket.

Childers Jacketing for insulated lines, made of .006" 3S alloy aluminum, was used to cover thousands of feet of line in Eastern States Petroleum's Houston plant.

As it does in over 1000 other plants in all 48 states and many foreign countries, Childers Jacketing helped save Eastern States many expensive hours of application and maintenance time.

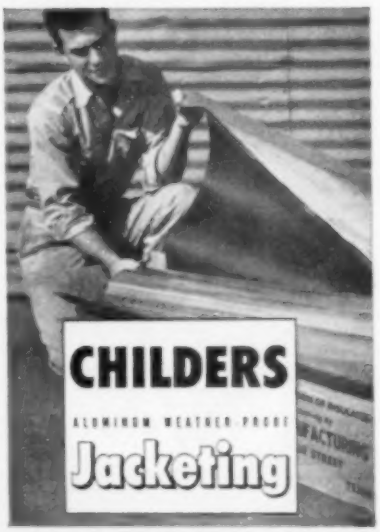
In fact, tests show this: Two men, working with Childers Jacketing for the first time, can cover more feet of insulated line in a day than with practically any other kind of covering. This means real savings in application costs.

The cost is low, too. You can actually put aluminum jacketing on your lines for less than the cost of the cheapest weatherproofing when one paint job is considered.

Immediate shipment from our large factory stocks can eliminate costly delays in construction or plant improvement schedules.

Try this low cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. Address: Childers Manufacturing Company, Department **CE-9**, 3620 West 11th Street, Houston, Texas.

Engineering representatives in most cities to work with you on jacketing problems.



Childers Jacketing arrives on the job in convenient rolls 4 feet wide and 100 feet long—easy for one man to handle. Jacketing comes with or without a moisture barrier attached to the back of the .006" aluminum. Rolls are well protected for field storage if kept dry. Boxes light enough for one man to carry. **(Adv.)**

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

FIG. 2342—Flanged End Bolted Cap Swing Check Valve for 150 Pounds W.P.

POWELL CORROSION RESISTANT VALVES

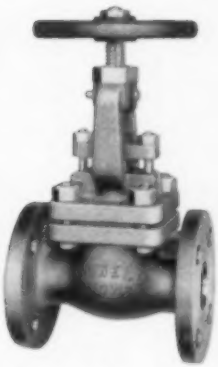


FIG. 2475—Stainless Steel O.S.& Y. Globe Valve for 150 Pounds W.P.

FIG. 2495—Double Disc Flanged End O.S.& Y. Gate Valve for 150 Pounds W.P.

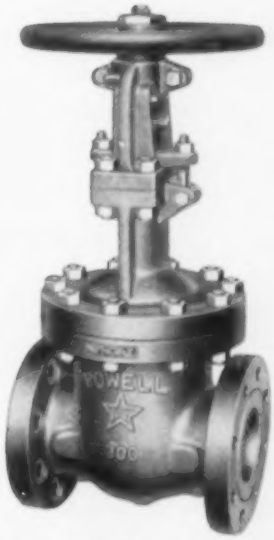


FIG. 3003SS—High Pressure Service Alloy Steel Gate Valve for 300 Pounds W.S.P.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

Powell can supply exactly the corrosion resistant valves you need . . . in a WIDE VARIETY of metal and alloys and all designs. You can be certain that every Powell Valve will give you dependable flow control.

Shown above are a few Powell Corrosion Resistant Valves. Investigate these . . . and the *complete* Powell line of quality valves that have a proven record of long, dependable service.

If no distributor is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write . . .

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year

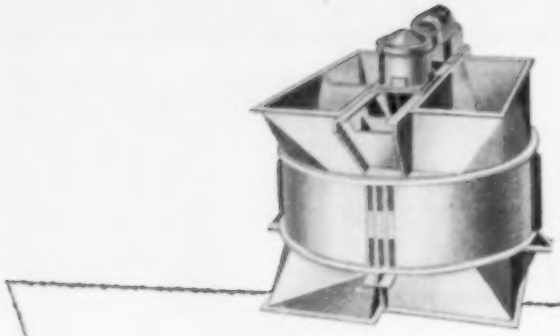
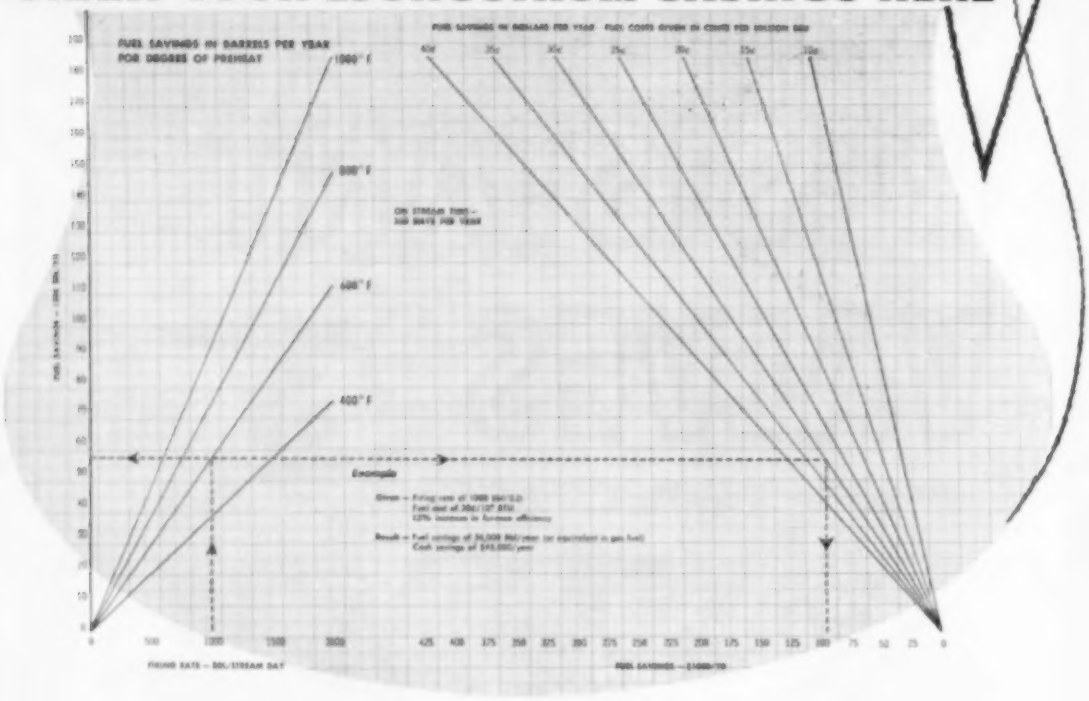


CHART YOUR LJUNGSTROM SAVINGS HERE



Start at the firing rate in your process units . . . allow a reasonable amount of air preheat (the higher the preheat, the more you'll save) . . . and look to the left for fuel savings. To convert that figure to cash — move to the right to your fuel cost line, and check your savings directly below.

The savings you'll discover for yourself are not fantasy, either. They simply prove why a Ljungstrom Air Preheater will pay for itself in eighteen months . . . a year . . . even nine months or less —in fuel savings alone!

And that isn't all. When you add to this the increased production . . . higher product quality . . . decreased furnace maintenance typical of operations including a Ljungstrom — you'll see why the Ljungstrom Air Preheater can be the oustanding factor in your refinery for *top economy and throughput*. Write today for full details.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

High Pressure Answer Men

Increasingly high pressures and temperatures used in processes today demand the most advanced engineering and metallurgical treatment of the piping and equipment to handle them. The M. W. Kellogg Company has earned a long-standing reputation in this specialized engineering area.

Largely responsible for M. W. Kellogg's position is the company's "Committee on Materials and Fabrication" which meets regularly to discuss developments of pure and applied research as they concern service experience, metallurgical progress, welding techniques, and improved methods of fabrication.

Composed of principal engineers from M. W. Kellogg's process engineering, mechanical engineering, and construction departments, as well as the Fabricated Products Division, this Committee benefits all of the company's activities and the facilities they offer in their respective fields.

The Committee on Materials and Fabrication is one reason why The M. W. Kellogg Company is recognized as the leader in the design and fabrication of piping, pressure vessels, heat exchangers, waste heat boilers, and process equipment requiring transient and maintained pressures and temperatures.

M.W. Kellogg

ENGINEERING FOR TOMORROW

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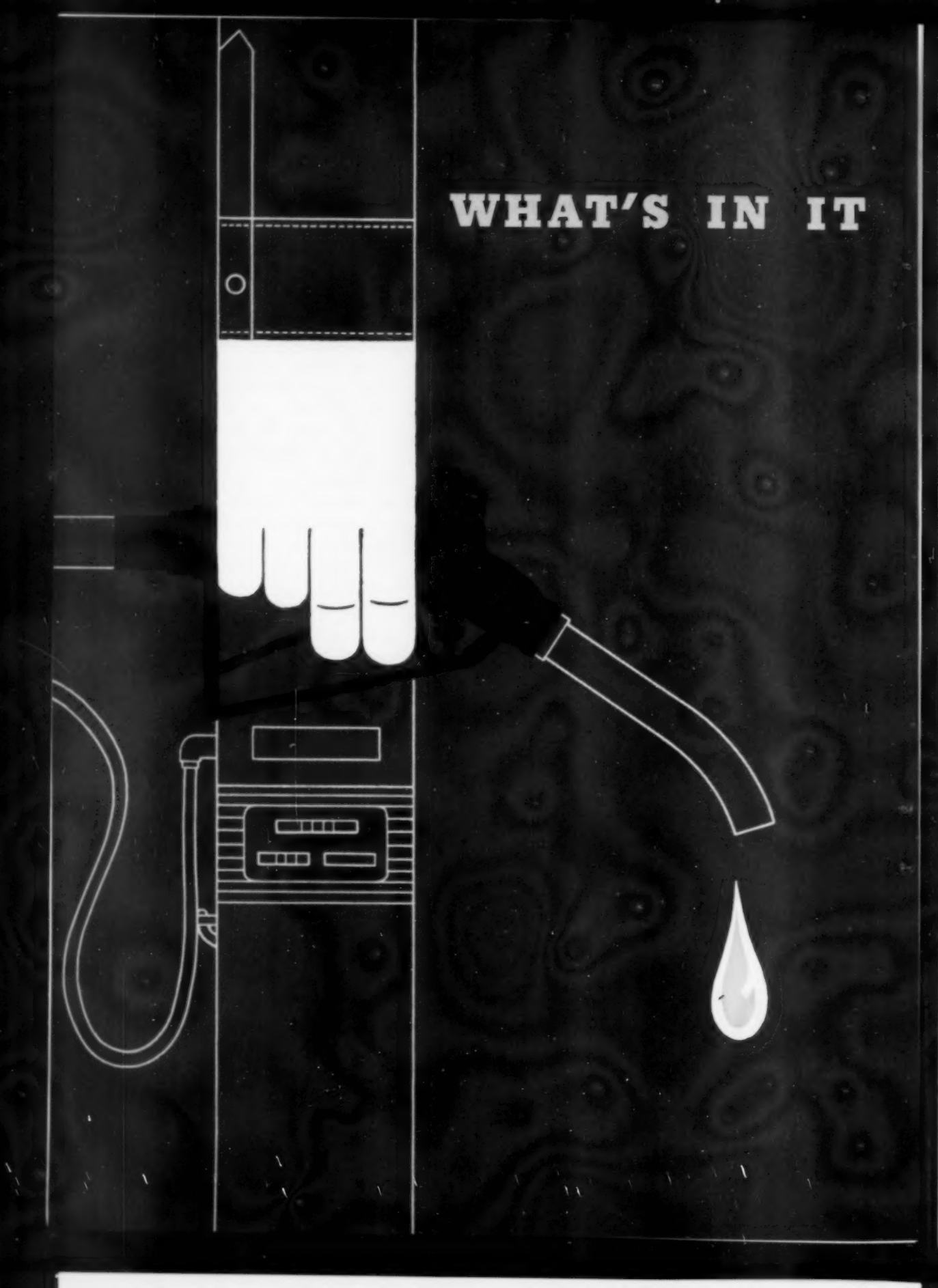

WHAT'S IN IT

FOR YOU?

How do you . . . or any other refiner . . . benefit from the installation of the UOP Platforming process?

If you are among the many refiners who have Platformers, you will know the answer to these questions. For instance . . . you will know that Platforming provides an economical method by which you can raise the octane ratings of straight run, natural and thermally cracked gasolines efficiently and economically to conform to your marketing requirements. Likewise, you may know that Platforming enables you to produce benzene, toluene, xylenes, and other aromatics which are readily recovered in an extraction process. And you will also know of the many advantages you receive from operating under a license from Universal Oil Products Company because of its well-established service policies which assure you of top notch performance at all times.

Platforming is the pioneer catalytic reforming process which first used platinum catalyst. Because of the nature of the Platforming catalyst, its activity is maintained for long operating periods without regeneration, resulting in important economies. And the unusual simplicity of operation throughout the entire unit is responsible for further savings.

Gasolines made by the UOP Platforming process have proved their leadership among motor fuels. They meet and beat severe competition, and build gallonage in any market . . . on a most profitable basis.

These are just a few of the advantages offered by this pioneer process . . . a few of the reasons why refiners the world over say, there's a lot in it for you.

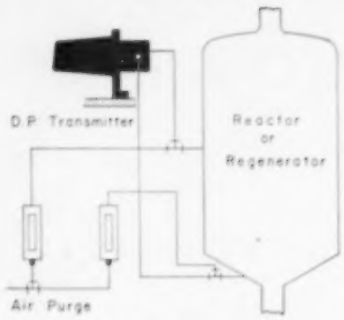
UNIVERSAL OIL PRODUCTS COMPANY

UOP

30 ALGONQUIN ROAD,
DES PLAINES, ILL., U. S. A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment

CATALYST LEVEL

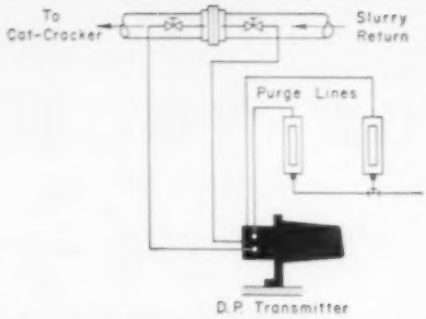


Problem: Sensitive Level Measurement of fluid catalyst in Reactor or Regenerator requiring a range of approximately 600 inches of water, and with a unit having parts common to other process measuring elements.

Solution: Use of a 333RD force-balance differential pressure transmitter with an available range adjustment of 80 to 800 inches of water.

Result: Accurate, Sensitive and Dependable level measurement with complete interchangeability of pneumatic transmitter parts.

AUTOMATIC PURGING OF SUSPENDED SOLIDS

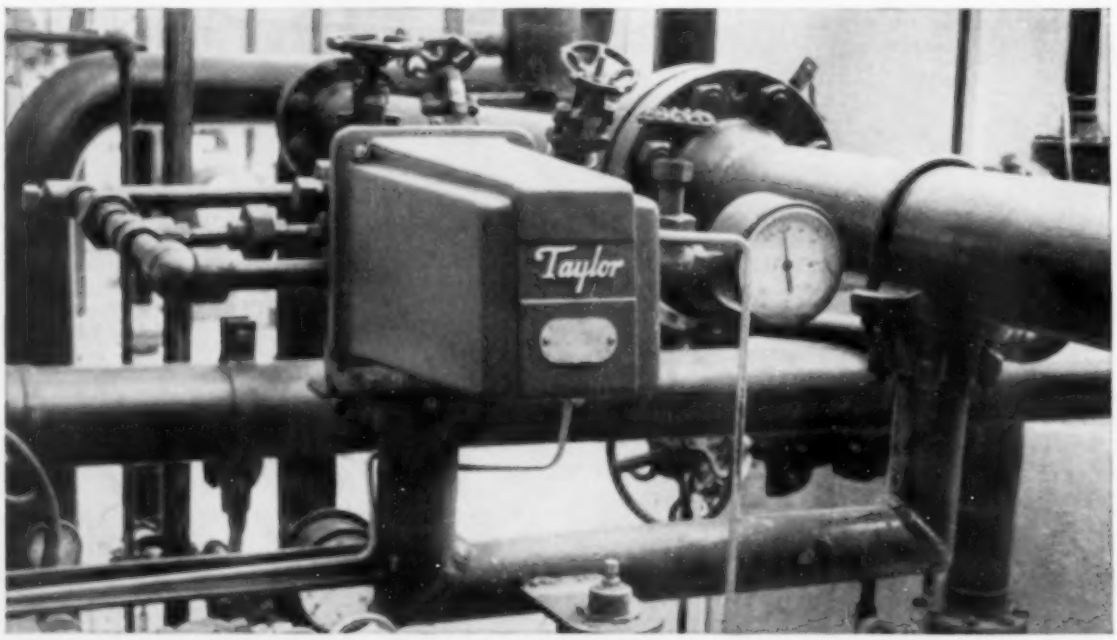


Problem: To obtain uninterrupted flow measurement and control in slurry lines where catalyst solids in suspension can settle out, plugging lead lines and meter, and causing measurement errors.

Solution: Dual body taps provide for purge connections which keep 333RD body, as well as lead lines, completely flushed.

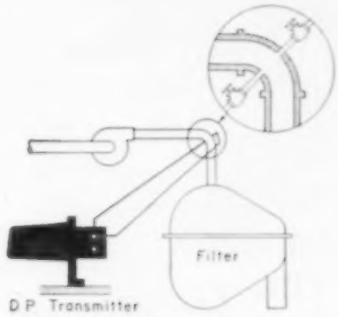
Result: Consistent, dependable high measurement accuracy. Flushing of transmitter body as well as lead lines cuts maintenance to a minimum, especially after shutdown.

A SIMPLE ANSWER TO



One of the TRANSAIRE Flow Transmitters on a reforming unit at Shell Oil Company's Wood River, Illinois, refinery.

SHORT RUNS—REVERSE FLOW—VARYING VISCOSITY

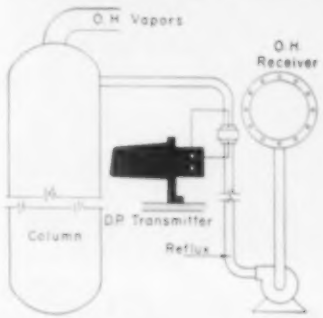


Problem: Dependable flow measurement installation where piping runs are too short for accurate orifice plate installation, the flow is reversed and/or flowing liquid has a varying viscosity.

Solution: The use of the 333RD Transmitter with Elbow Taps as primary elements. Since there is a tendency toward cavitation at the inside tap, the low volumetric displacement of the 333RD makes this type of installation practical.

Result: Accurate measurement and control under any one or more of these three difficult conditions.

WHEREVER A GOOD "WORK HORSE" IS REQUIRED



Problem: To improve flexibility, as well as reduce installation and maintenance costs of conventional flow instruments.

Solution: Standardizing on the 333RD Transmitter. 10-to-1 quick and easy range change; minimum volumetric displacement; may be installed for continuous draining and venting; light weight.

Result: Reduced maintenance cost due to time saved installing, changing of range, and eliminating periodic draining or venting.

DIFFICULT PROBLEMS!

The Taylor TRANSAIRE® Differential Pressure Transmitter (333RD) combines rugged simplicity with remarkable adaptability!

THREE of the applications illustrated above present difficult flow and level measurement problems: the fourth is an every-day installation. In each case the 333RD Transmitter handles the job accurately, dependably and economically.

This very versatile instrument is inexpensive and easy to install, and to maintain; changes in product or seasonal demand cause no problems, due to quick, simple range-change features; it follows flow changes quickly because of low volumetric displacement—has no seal pots.

Some of the features that make it so popular for refinery applications, are:

1. Good overrange protection, due to precisely designed and manufactured back-up plates and use of strong, flexible Teflon-coated glass fabric diaphragm.

2. Negligible temperature effect resulting from proven design principles and use of low-spring-rate materials.

3. Ease of range suppression by means of an easily accessible, easily adjustable spring.

If you need dependably accurate measurement of flow, liquid level or specific gravity, it will pay you to look into the 333RD. Call your Taylor Field Engineer, or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

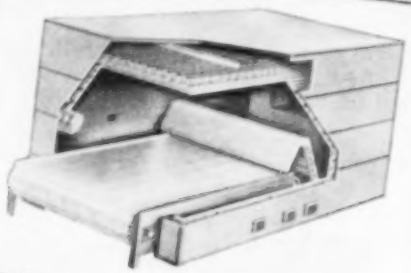
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

MOIST FUEL CELLS

An important application of B-L unit-suspended walls and arches is found in furnaces where a fuel with a high moisture content is burned. Although designed primarily for use in cane sugar countries for bagasse burning, these furnaces have proven so successful in other fields such as the burning of bark and wet wood refuse.

BIGELOW-LIPTAK Corporation

UNIT-SUSPENDED WALLS AND ARCHES



DRYER FURNACES

A tough assignment for a furnace is to stand up under the every-day beating of heat in drying applications. B-L's streamlined thin wall dryer furnace does it—cuts maintenance to boot. It furnishes heat for drying coal, sugar, salt, lumber, chemicals.

BIGELOW-LIPTAK Corporation

LOWEST MAINTENANCE

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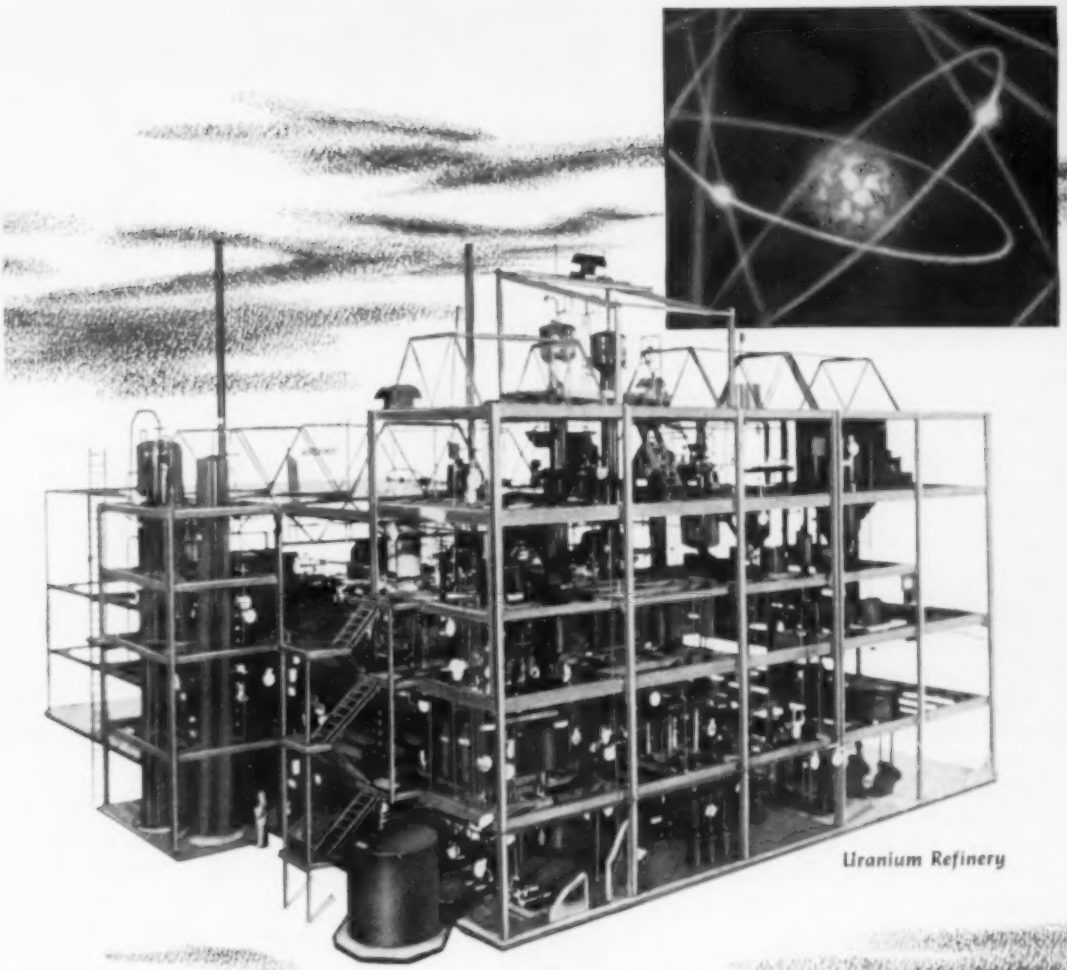

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The full scale commercial uranium refining plant—of which this is a model—is now under construction at Port Hope, Ontario, and will be completed in 1955, the first of its kind in Canada. With engineering and construction by Catalytic, it will make available to Eldorado Mining and Refining, Limited (a Crown Company) the most advanced processes for uranium refining. This new example of our services in advancing uranium technology portrays Catalytic's position of leadership in the industry of tomorrow. We welcome your inquiries today —that Catalytic's on-time, on-budget services may contribute to your success of tomorrow.

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CLAD STEEL CUTS CORROSION IN NEW TWIN REACTORS

This 25,000-barrel-per-day Houdriflow cat-cracker features twin reactor-kilns built into one large vessel for the first time. But designing this unit presented many problems. The reactor, for instance, had to resist corrosive action of the crude fraction at temperatures in the neighborhood of 950°F. To get *economical* corrosion resistance, stainless-clad steel was specified for the cone, shell and an internal head.

To get economical performance like this in other major units of this refinery, stainless-clad steel was specified for the atmospheric, vacuum and synthetic crude towers and for the flash fractionator to minimize corrosion, downtime and equipment failure. The light layer of cladding, inseparably bonded to the carbon or low-alloy backing steel, gives the performance of expensive solid high-alloy plate at much lower cost. Strength and rigidity are supplied by the backing plate.

Now this refinery is ready to meet increasingly competitive conditions as the result of an expansion program that raised operating efficiency and tripled throughput. While still in the planning stages, the refiner's engineers called on the equipment builder to help translate their ideas into the specialized equipment needed. His particular knowledge of fabricating techniques utilizing clad steel helped put this refinery ahead in output and profit. You, too, will find that it pays to consult your fabricator early in your planning for equipment that is lower in cost, longer lived and requires less maintenance.

Clad steel in this Houdriflow cat-cracker provides economical corrosion resistance at high temperatures

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or contact Manager, Marketing Service, Lukens Steel Company, 752 Lukens Building, Coatesville, Pa.

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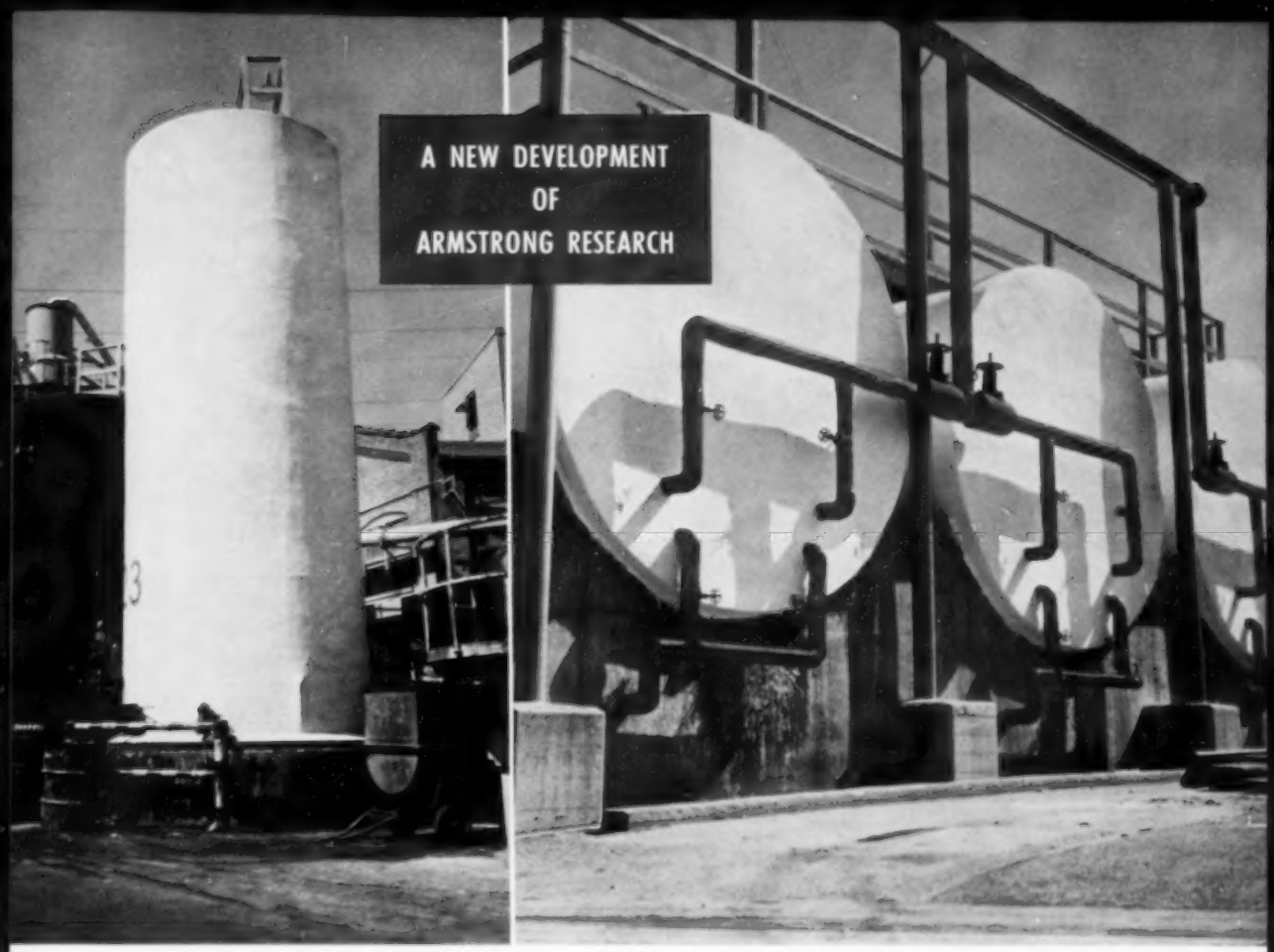

Insulcolor ... *a rugged plastic finish for insulation—indoors and outdoors*

Now you can apply a protective finish to insulated tanks and lines that serves as color identification, too. New Armstrong Insulcolor provides a durable plastic finish in seven colors or white.

Under the most severe outdoor conditions, Insulcolor* will not crack, craze, or peel. The rugged plastic film withstands extremes of temperature and has excellent water-resisting properties. Bumping and abrasion won't damage Insulcolor's smooth, tough surface.

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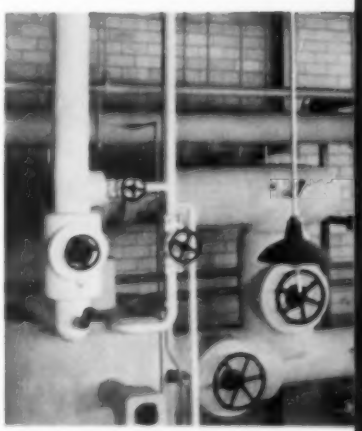
Available through Armstrong's Contract Service, Insulcolor is one of the new products developed by Armstrong Research in the industrial insulation field. For full details on Insulcolor and Armstrong's Insulation Contract Service, call your nearest Armstrong office or write Armstrong Cork Company, 205 Stratton Street, Lancaster, Pennsylvania.

*Trade-mark



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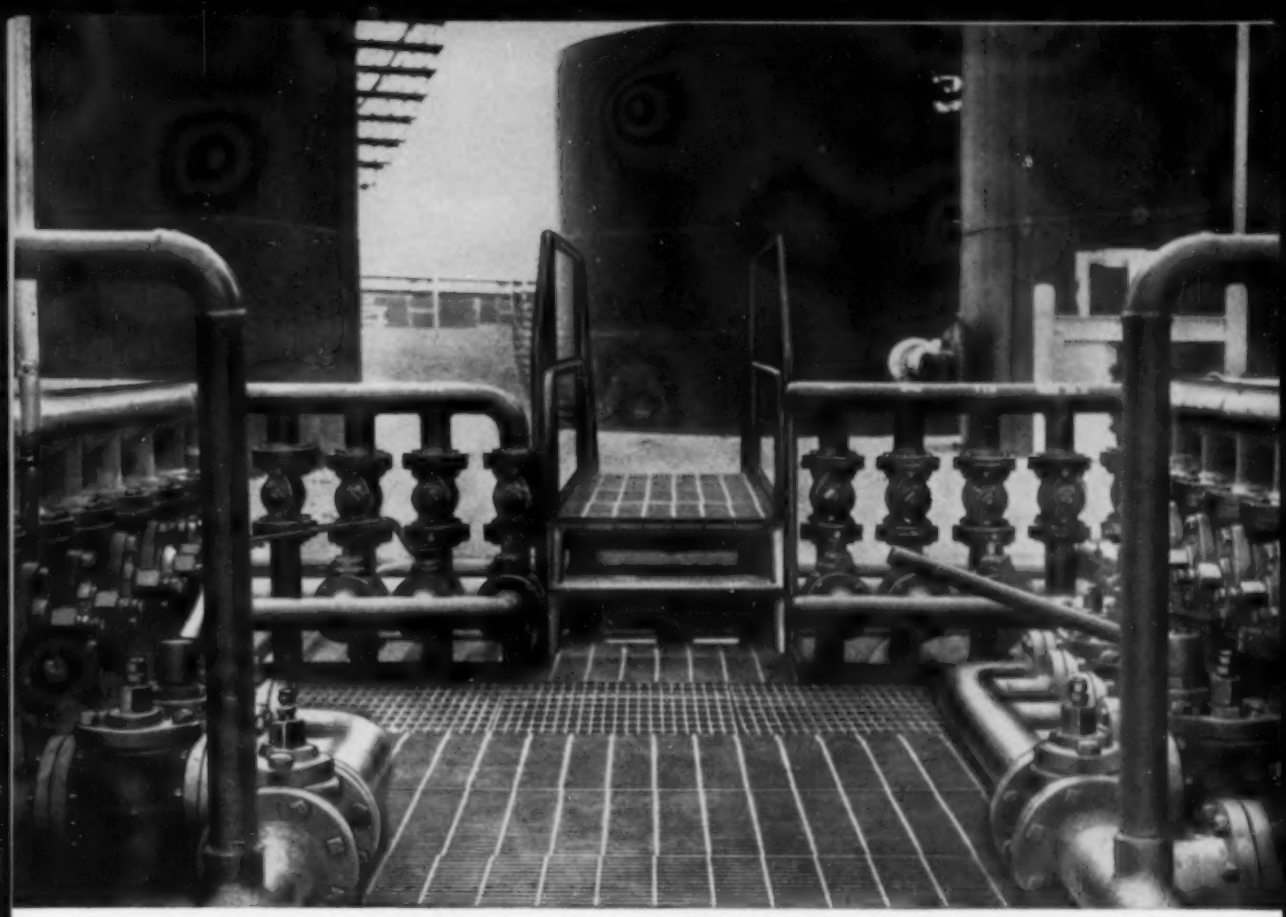

Costs Down...Production Up

because **Rockwell-**Nordstrom **Valves** perform better, longer, for less money!

In key spots, where dependability is vital, you *expect* to see Rockwell-Nordstrom valves. They were created forty years ago for the tough jobs ordinary valves couldn't handle.

But now you also see them—by the hundreds *and thousands*—in "routine" services like the tank manifold shown above, and for the same basic reasons:

—they're ruggedly dependable, yet cost no more than ordinary valves.

—they're pressure-lubricated, to provide a truly tight, dependable seal...

—the lubricant film prevents grinding metal-to-metal wear, means longer life, less downtime, lower maintenance cost...

—quarter-turn, and the hydraulic-jack action of the lubricant, make them quick and easy to operate, once a day or once a year...

Rockwell-Nordstrom is the *original* lubricated plug valve, and for 40 years has been the plug valve leader. That's why Rockwell can give you the most complete range of sizes, pressure-temperature ratings, body designs, and metals.

Why not standardize on Rockwell-Nordstroms—and genuine Rockwell-Nordstrom lubricants—for your fuel, products, supply and transfer lines? You'll get better valve service than you've ever had before, and at lower cost per year. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

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ROCKWELL-Nordstrom VALVES

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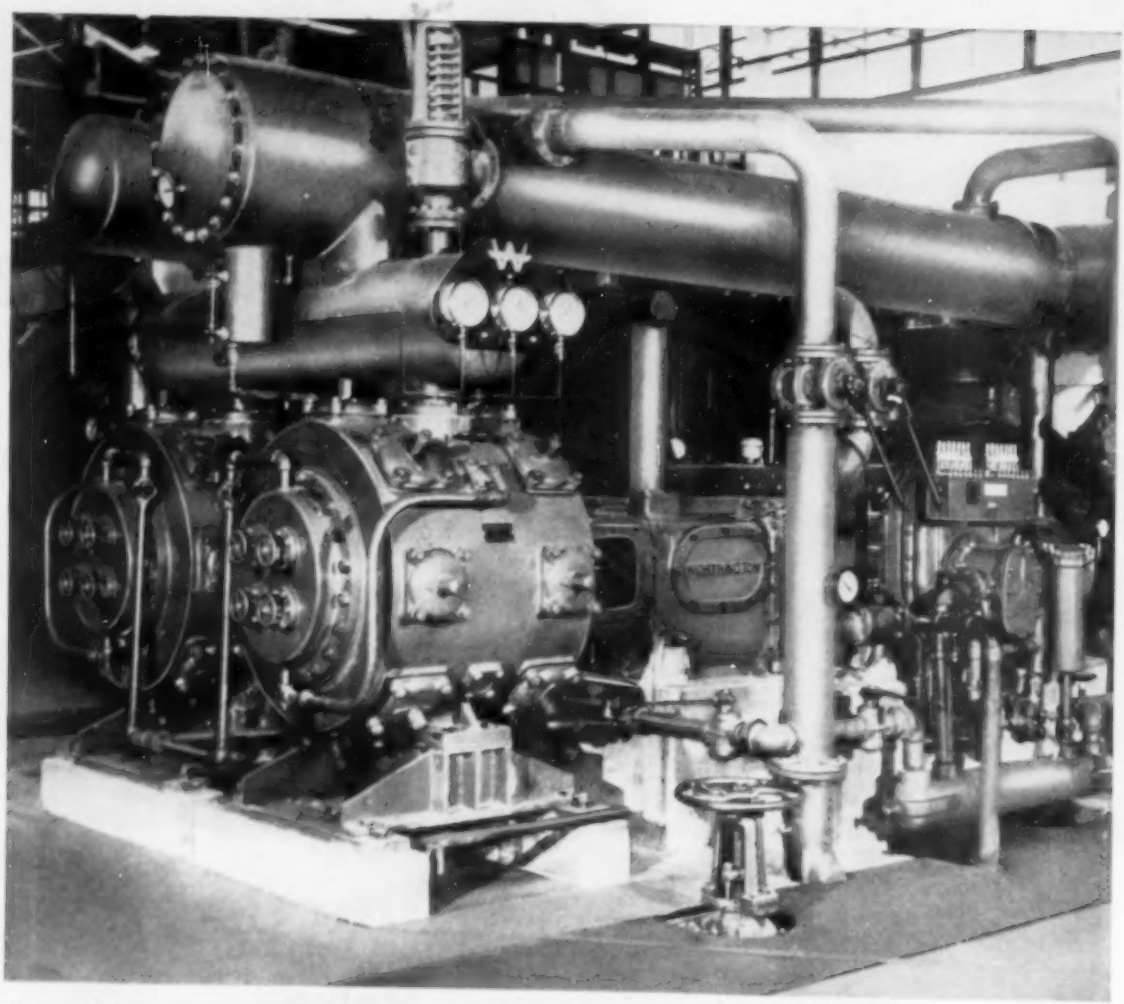
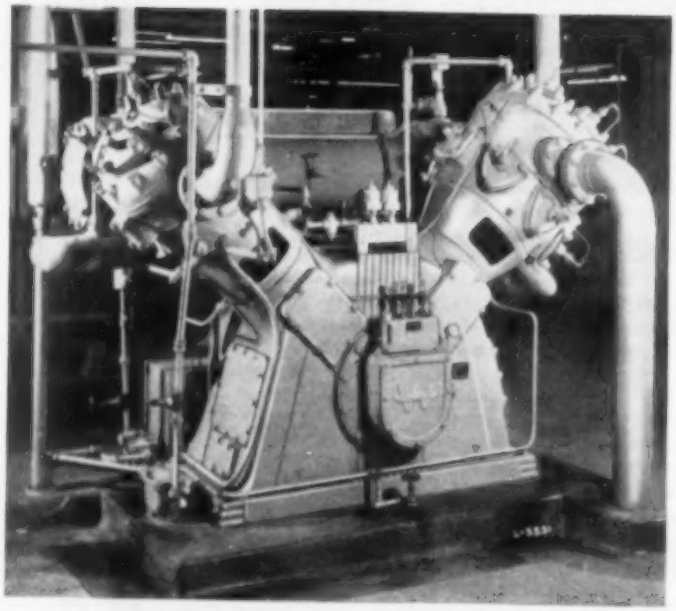
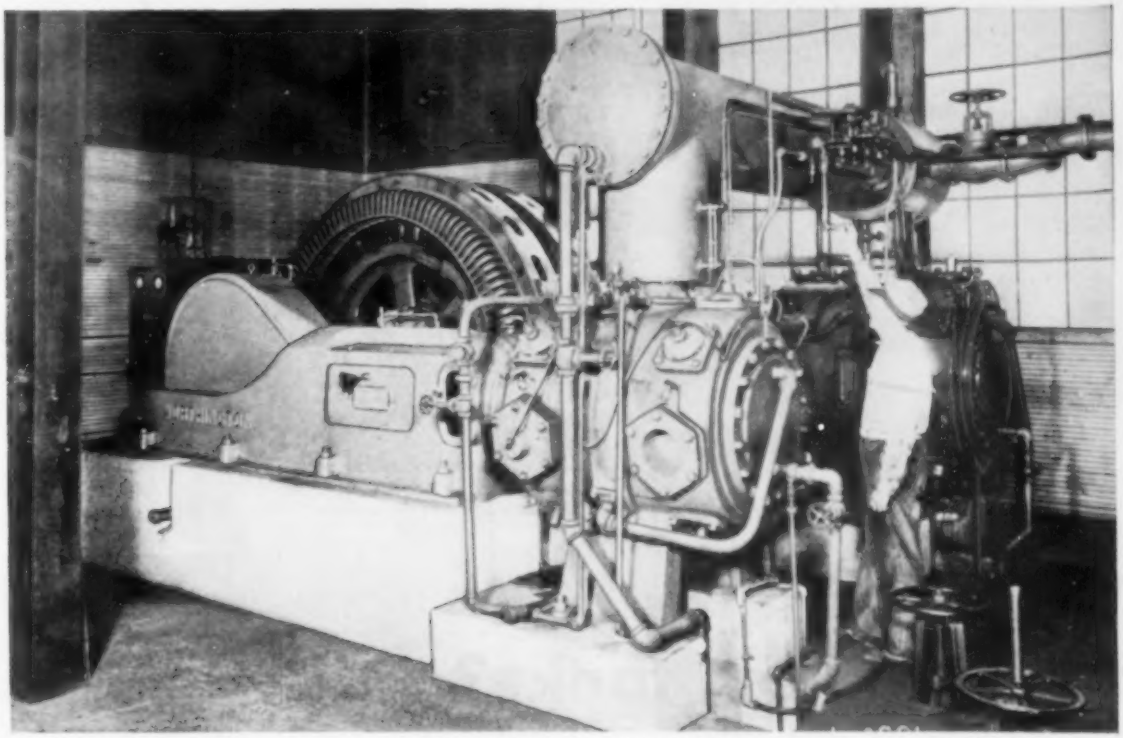




LOOKING FOR VERSATILITY? Worthington's modern, balanced-opposed type compressor really fills the bill. Units like the one shown above (at work in a large chemical plant) are ideal for either multiple- or single-service applications. They're also widely used for high-pressure, multi-stage work as well as low-pressure jobs. Like the rest of the large Worthington compressor family, the versatile balanced-opposed unit is equipped with the exclusive Feather* Valve, the lightest, tightest, most efficient valve made. Sizes range from 400 to 5000 hp. *Reg. U.S. Pat. Off.

GREAT SAVINGS IN INSTALLATION COSTS. The "packaged" Worthington Y-type compressor is delivered completely assembled, with no lining-up to do in the field. It needs only a small, simple foundation — and can be placed in operation within hours after it has been set on the foundation. Sizes range from 75 hp to 350 hp.

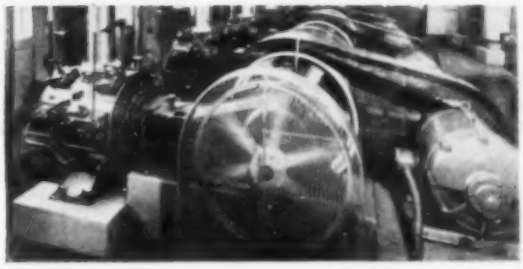
(To obtain more data on advertised products see page 264)



FOR HEAVY-DUTY, day-in-day-out operation at top capacity, the Worthington DC compressor is the right choice. These dependable compressors have been making friends for us for over fifty years. Sizes range from 250 to 2500 hp.

Get the right compressor for the job

Because Worthington builds every type and size of compressor and compressor drive, you're assured of getting unbiased compressor recommendations



DEPENDABILITY. That's what you get with the Worthington HB compressor — smaller version of the DC. For an economical, continuous supply of air in smaller quantities, the HB's are unexcelled. They can be used as single-stage units or hooked up in tandem for two-stage work. Sizes range from 10 to 125 hp. K.4.8

We'd like to hear about your compressor needs. Write to Worthington Corporation, Water-Cooled Compressor Division, Section K.4.8, Buffalo, New York.

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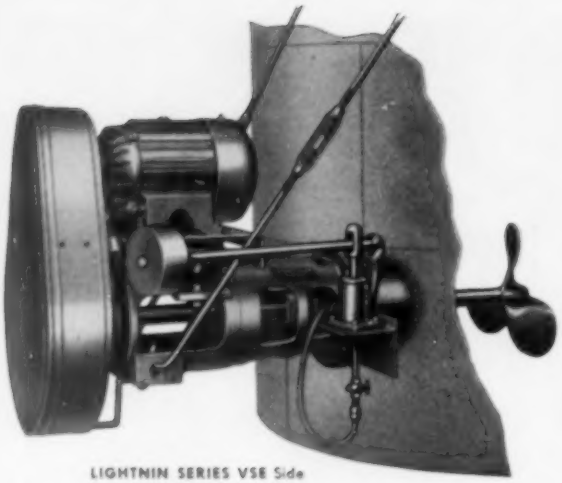
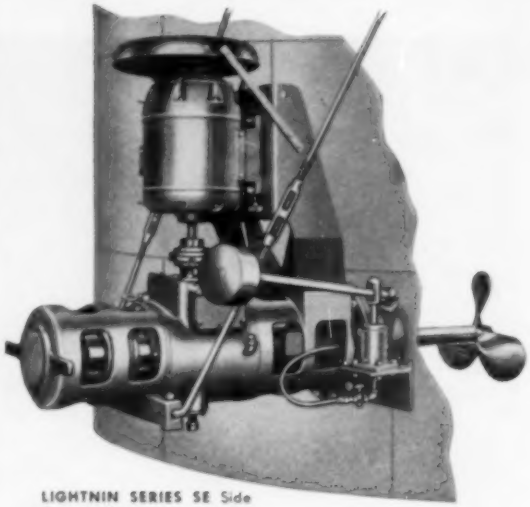


LIGHTNIN SERIES VSE Side Entering Mixer . . . V-belt drive.



LIGHTNIN SERIES SE Side Entering Mixer . . . gear drive.

Which mixer is best for *YOUR* big tanks?

The bigger the tank, the more economical it is to choose mixers closely matched to your needs.

You want just enough power to give you rapid, thorough tank turnover—but no wasted HP.

That's why each of the LIGHTNIN Mixers shown above is supplied in *nine* sizes, from 1 to 25 HP.

What's the best shaft seal?

Your operating conditions may call for any of *four* standard LIGHTNIN stuffing boxes, or a full range of rotary mechanical shaft seals. In any case, the type you need is available and has been proved in use.

How about motors?

Years of trouble-free maintenance may depend on your choice of a motor. With LIGHTNIN Mixers, choose from standard horizontal foot-mounted or vertical flange-mounted types, in all enclosures, and a wide range of special motors. All are fully guaranteed.

Getting the right materials

If corrosion or chemical attack is a problem, you can have the mixer's wetted parts in Carbon Steel, Types 304 and 316 Stainless, Everdur Bronze, Monel, Nickel, Hastelloy B or C, or any other commercially available alloy or metal, and with rubber, lead or other types of covering.

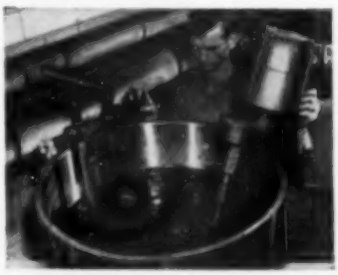
No risk; here's why

Finally, the LIGHTNIN guarantee protects you two ways: against mechanical failure; against process failure. Every LIGHTNIN is guaranteed to do the job for which it is recommended, or your money back.

If you're thinking about mixing or blending in big tanks, ask your nearby LIGHTNIN man to give you the facts. You can get started *now*, without any obligation, if you call him today.

EASIEST MAINTENANCE EVER . . . with either type, tank shutoff is actuated by turning these easy-to-get-at handles, for repacking or changing rotary mechanical seal with tank full.

FOR PETROCHEMICAL MIXING, hydrogenations, solids suspensions, high-efficiency stripping operations, LIGHTNIN Turbine Mixers offer complete adaptability. Sizes 1 to 500 HP.



FOR CAUSTIC TREATING, feed water treating, preparing specialties, and dozens of other jobs, you can standardize on LIGHTNIN Portable Mixers. Thirty models. Sizes ⅛ to 3 HP.

Lightnin® Mixers

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- ☐ B-104 Side Entering Mixers
- ☐ B-106 Condensed Catalog (complete line)
- ☐ B-107 Mixing Data Sheet
- ☐ B-108 Portable Mixers (electric and air driven)
- ☐ B-502 Mud Mixers (oil well drilling)
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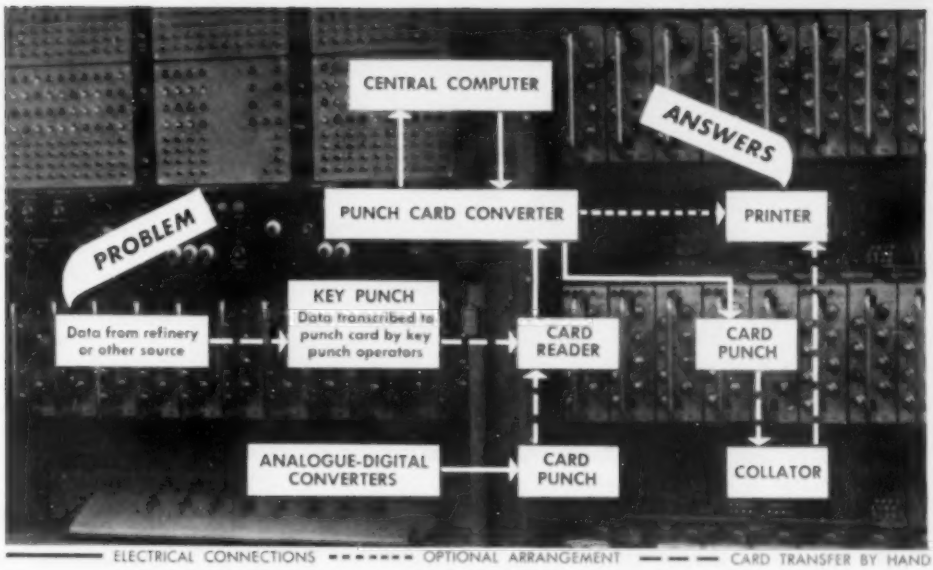


HOW PLANNING PROBLEMS FLOW through the new electronic computer system

Why a Computer for Refining?

Faster than humans-yes—but Socony-Vacuum says there are at least four other advantages

by WILLIAM C. UHL
Managing Editor

SUPPOSE you were forced to make a quick decision of considerable economic weight on a new source of crude oil? In addition to the "Yes-or-No" answer, you'd have to figure out how the crude was to be processed—based on its properties and specifications—so as to continue making the same amount, or even more, of the same quality products you'd been making previously.

Such decisions take many man-hours of painstaking calculations with as high an accuracy as is humanly possible. Faster and still more accurate answers can mean a reduction in lost time, and consequently costs. Figuring in all the factors can mean learning how to operate the refinery to make the most profit.

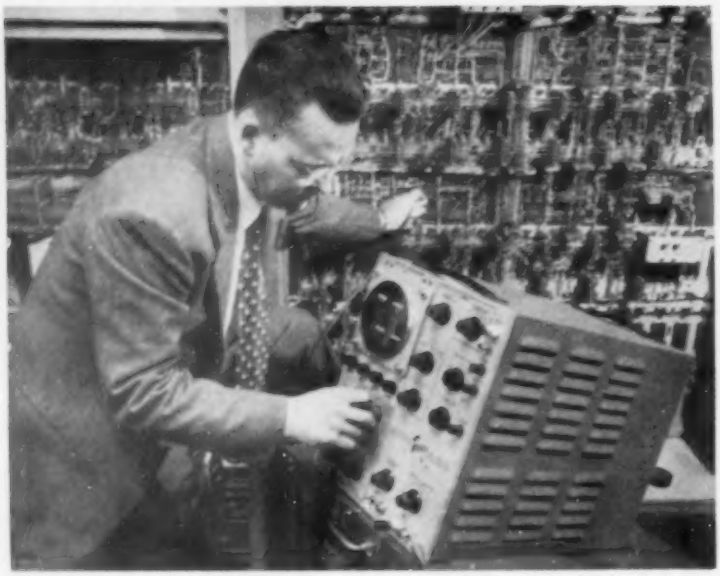
With the new $135,000 electronic digital computer Socony-Vacuum Oil Co., Inc., has installed at its Paulsboro, N. J., research center, the company feels it can solve problems like this to the greatest possible economic advantage to the huge refinery adjacent the research laboratories. And eventually, similar operating problems at other refineries of the company can also be fed to the Paulsboro computer for handling.

Socony estimates the computer will handle a problem in about 15 minutes which would take an experienced refinery engineer about two weeks to solve.

But this is just one job and one factor justifying the existence of the new computer, nicknamed "Mobilac." Among other potential uses, according to William M. Holaday, director of Socony-Vacuum Laboratories, are: ". . . refining process development, catalyst research, reactor design, crude oil analysis, and gasoline blending.

"For instance, in combination with a mass spectrometer (for identifying the molecular structure of hydrocarbons), the high-speed computer will enable us to make more rapid and much more detailed analyses of crude oil, lubricating oil stocks, and waxes than any presently used analytical tools. This in turn may make possible further improvements in the quality of lubricating oils and waxes."

Advantages beyond computation itself are also



RUNNING A TEST on Socony's new computer, electronics engineer L. L. Gainey of ElectroData Corp. uses an oscilloscope

highly important factors in the installation and operation of the Paulsboro instrument. As seen by the refinery planning and process economics department, these include:

1—It will free trained engineers from routine calculating tasks—jobs which can be performed by technicians and clerical personnel with a minimum amount of training—giving the engineers time to do more original thinking.

2—More process and economics problems can be handled by the planning department. Many times, this group simply couldn't do some problems—they were too long and too complex—and all the group could do was to take a "calculated risk."

3—The planners can be confident they are getting answers more closely approaching true optimized operations.

4—With the machine handling more details, the human beings will be able to look more closely at many more variables in each problem, perhaps coming up with still more different ideas as to the best way to handle each specific problem.

For example, what has the planning group been faced with before? Say, they had to develop an optimum operating schedule on a given crude supply when they have as many as 30 different crudes on hand or available. They have to find the best combination of these crudes to get the best kind of products, the highest yields, for the best prices, at the lowest operating and maintenance costs.

This has meant almost an infinite number of calculations and of course a long period of time to get an answer. With the new computer, a set of calculations can be fed through and a set of procedures and answers obtained in a relatively short time.

What about long range planning? Does the computer have a role to perform there too, like the more immediate and short-term problems discussed above? What will the refinery manager have to do to meet competition on quality and quantity of products in the future? Such projections may go ahead as far as three years on an explicit and detailed basis, and perhaps 10 years on more general terms.

The computer can do a job here too. For a concrete example of a possible application, the Socony-Vacuum planners cited catalytic reforming. This is a process with the primary aim of supplementing catalytic cracking to produce more high octane fuel from the same barrel of crude, but with a very important secondary possibility of producing aromatics useful in the manufacture of petrochemicals. A decision on whether it's worth using, when it should be used, and how to use it involves problems all possible of solution on the computer in the form of mathematical equations.

Because of the greater accuracy possible with the computer, Socony-Vacuum is currently engaged in using it to replace a number of cracking correlation charts. When using these charts, the engineer has to use a straight-edge and a sharp pencil. And he still must do a certain amount of interpolating. These interpolations, plus the trueness of the straight-edge, plus the thickness of his pencil point, plus possible variations in the thickness of the chart lines, all contribute to further possible errors on the part of the engineer using the graphical chart method. The effect of small changes in the operating conditions may be entirely masked by these chart reading errors.

The computer cannot make this kind of error. Accuracy as a result is superior. However, if there was an error in the original data from which the charts were developed—and it is this original data which the computer uses instead of the charts—then the machine cannot compensate for such errors.

The computer will not make the refinery automatic—or perhaps it should be expressed: more automatic. Today's refinery already is one of the most automatic pieces of equipment developed and in use by the manufacturing industry.

What it will do is enable the refinery manager, the refinery operator, to make the same decisions he makes now, but make them much faster and more frequently.

The way the Paulsboro unit works is this: Take for example, one of its principal jobs—the calculation of optimum conditions of refinery operation.

To solve such a problem, a mathematical model of the refinery is needed because the vocabulary of the computer is numbers, and its grammar is arithmetic and logic. This mathematical model is essentially a group of equations which take factors such as crude oil characteristics, cracking unit operating conditions, product commitments, motor gasoline specifications, available charge stocks, and the like; and by adding, subtracting, multiplying, and dividing these factors in the proper way tell what salable

THIS MONTH'S COVER . . .

. . . shows L. L. Gainey, electronic engineer for ElectroData Corp., builder of the computer, pointing out a technical detail in the instrument to M. L. Deutsch, mathematical physicist (left) and T. W. Nelson, director, of the Paulsboro, N. J., research and development laboratories of Socony-Vacuum Oil Co., Inc., where the new machine is installed.

products will come out of the refinery.

Every problem must first be expressed mathematically, and then it must be broken down into a set of step-by-step commands—a program—which is essentially a description of the problem in computer language. These commands, expressed numerically, are then punched on cards, which are read by the computer system and stored in its memory. The problem is then solved, the answer punched out on cards and subsequently printed in a form suitable for direct use in reports.

Such a mathematical model has already been set up for the light products section of Socony-Vacuum's Paulsboro refinery. About 100 equations are required to express the behavior of the cracking, reforming, and alkylation units, and the various blending operations. When expressed in computer language, this becomes a program of some 6000 commands.

These commands operate on approximately 200 data items which are supplied by the refinery management every time it wants a problem solved. It is important to note that the program of 6000 commands is punched on cards *once and for all* and contains built-in provisions for changes in refinery operating conditions and the crude being run. Only the 200 data items require processing for each problem: they vary with each problem. These data items can be punched on cards in less than three minutes and the whole problem fed to the computer and solved in about fifteen minutes.

An experienced engineer would take about two weeks to do such a problem in the same amount of detail and with the same degree of accuracy as the computer. However, it is pointed out that the engineer could and does handle such problems in shorter periods of time by using short-cut methods to get his answers in less detail and at lower accuracy.

The 6000-command program itself is broken up into "blocks." There is a block for cracking, a block for aviation gasoline commitments, a block for reforming, etc. The calculation is directed by a "master routine," itself one of the blocks, and comprising about 100 commands.

For use for another refinery with a different set-up than at Paulsboro, a different master routine would have to be programmed. But, the basic blocks of the Paulsboro program (e.g., cracking, reforming, etc.) could be used as is, in general. Application to other refineries would, therefore, be analogous to using an Erector set for which there is already created the basic structural units. If changes are made in refinery equipment, new blocks can be added to the program.

PUSH-BUTTON OPERATION—T. W. Nelson, director of the Paulsboro laboratories, and Miss Ann Tierney, technician

The "flow chart" illustrates how problems flow through the complete computer system at Paulsboro. Data is transcribed by human operators to a punch card on a key punch machine. "Decks" of cards comprising the specific problem are then transferred manually to a card reader. At the same time, the cards carrying the program commands have been prepared and likewise are brought to the reader.

The analog-digital converter shown in the chart provides another means for getting problems into the computer. For example, it is now taking data from a mass spectrometer, converting it to digital form, and operating another card punch.

Flow then is by electrical connections: from the reader through a punch card converter to the central computer and then back to the converter. At that point, results may be sent directly from converter to a printer or to a card punch. From the card punch, cards are transferred manually once more to a collator and then to the printer.

The central computer, an electronic digital type, was manufactured by the ElectroData Corp., Pasadena, Calif., an affiliate of Consolidated Engineering Corp. ElectroData also built the punch card converter and the analogue-digital converter. All other units in the system are products of International Business Machines, Inc.

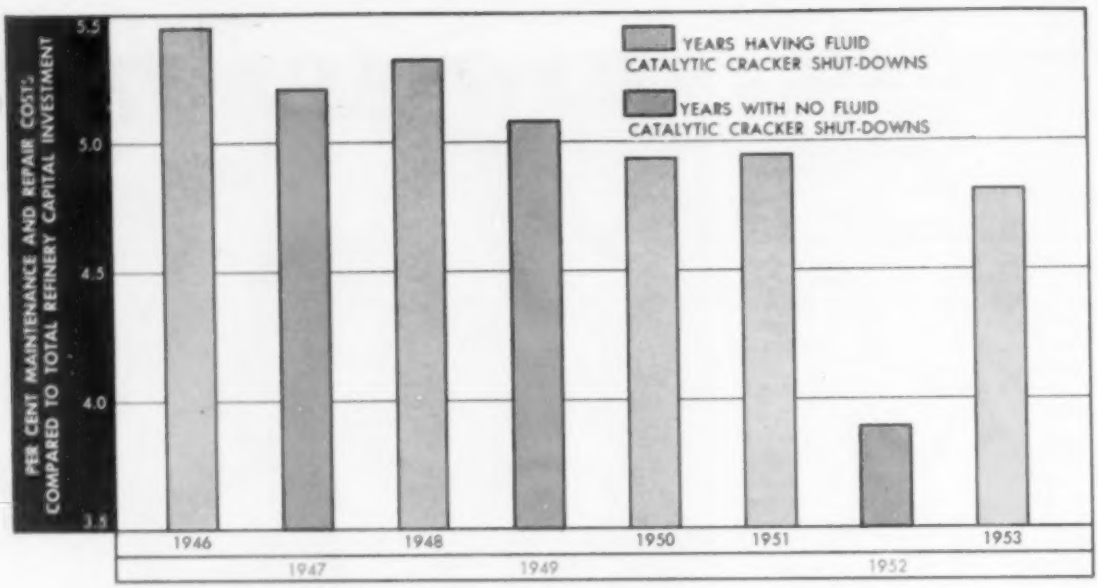
Refinery computer application is not new to Socony-Vacuum with this latest instrument. The first unit was installed in the Paulsboro laboratories in December, 1951, and was an IBM mechanical type digital calculator. The point was soon reached where this wasn't big enough to handle all the jobs being brought in.

In June, 1952, the earlier unit was supplemented by an IBM Card Programmed Calculator, part electronic and part mechanical in operation. Then, in November of last year, the latest unit, an all electronic digital computer built by ElectroData was installed, along with the IBM auxiliary equipment.

Socony has favored the digital type of computer over the so-called analog type, because they believe it has much wider and more flexible applications. A digital computer handles actual numbers—and is much like a super abacus. An analog computer represents the numbers by physical quantities, such as electrical voltages. The physical quantities are inter-related in the same way as those in the actual problem.

Acknowledgment

The author expresses thanks to the Socony-Vacuum Oil Co., Inc., for making this information available and particularly appreciates the assistance of E. S. Nicholls, O. H. Clark, M. L. Deutsch, J. S. Hicks, and F. M. Conway.



MAINTENANCE and repair costs down—Planning and scheduling up

Maintenance Dividends for You

. . . by incorporating planning and scheduling functions within your maintenance organization

By CREIGHTON C. CARMINE
Superintendent of Maintenance and Construction
Tide Water Associated Oil Co.
Avon, Calif.

ONE OF the major maintenance problems in a petroleum processing plant is to preserve a reasonably steady balance between maintenance work requirements and manpower—or what to do with maintenance personnel between peak loads.

Tide Water Associated Oil Co. solved the problem at its 100,000 b/d Avon, Calif., refinery by adding planning and scheduling to the execution function in their Maintenance and Construction Department. This arrangement allows maintenance personnel to be gainfully employed between peak loads on authorized new construction, alterations, dismantlements and large maintenance jobs.

Results achieved by such changes are reflected in the fact that the ratio of maintenance and repair costs to total refinery capital investment has been reduced appreciably since 1949 as shown in the chart. This is in comparison to a probable average of 5 to 10% for the refining industry.

During the latter half of 1950 the company employed a consulting engineering firm to conduct a survey and make recommendations to improve the organization and operations of the refinery, emphasizing the functions of maintenance and construction work by refinery personnel.

Other refineries generally had solved the problem in one or combinations of the following ways:

1. Contracting out all maintenance and permitting a contractor to hire and fire as the work requirements demand.

2. Maintaining a nucleus of maintenance men permanently and contracting for all maintenance requirements above this level.

3. Providing a maintenance organization of sufficient size to handle all maintenance requirements at peak load, and gainfully employing the personnel on other authorized projects between peak loads.

The third plan was adopted by Tide Water Associated at its Avon Refinery with the exception that a portion of the maintenance and repair work on the shut-down of its Fluid catalytic cracking plant is performed by outside contractors. During 1951 and 1952 the Maintenance and Construction Dept. was completely reorganized and a formal planning and scheduling system was introduced for handling maintenance and construction.

Under the new plan, an average of 15 to 20% of the M & C Dept. manpower is employed throughout the year on work charged to capital or investment account. In addition, the department is continually employed on maintenance and repair projects which are within the capacity of the men and equipment available. Other projects involve alterations chargeable to either capital or maintenance and repair accounts, dismantlements, road repairs, rerouting of pipelines, preparatory work for outside contract jobs, work for other divisions of the company, reconditioning material and equipment for the storehouse and fabricating items for storehouse stock.

Capital improvement projects, alterations and repairs beyond the capacity of the department are given to outside contractors on a competitive basis. These include items such as

turnkey jobs for new process units, buildings, waste water canal dredging and repairs or replacement of tanks.

Open contracts are negotiated with one or two reliable outside contractors on an annual basis to provide flexibility for meeting sporadic unusual peak maintenance requirements in certain crafts—such as brickmasons and laborers, repairs to furnace brickwork and insulation, cleaning tanks, cleaning open pipe conduits, hand excavation work, etc.

Work Priorities

Satisfactory operation with a reasonably fixed complement requires a job priority basis with some administrative responsibility fixed for assigning the priorities.

Priorities at the Avon Refinery, in approximate order of importance:

1. Emergency jobs including emergency shutdowns of process units.
2. Planned process unit shutdowns.
3. No. 1 priority maintenance jobs involving meeting a scheduled date.
4. Work to be performed by refinery personnel to meet an outside contractor's scheduled starting date.
5. No. 1 priority project jobs—maintenance and repairs or capital investment—performed by refinery personnel to meet a scheduled date.
6. Scheduled preventive maintenance.
7. No. 2 priority maintenance and project jobs with flexible completion dates.

Other items which must be considered include fixing the total complement as low as possible allowing for vacation and sickness relief for other departments as well as its own, minimizing lost time when moving men of 15 different crafts between various jobs, and getting material to the job site promptly with the start of the job.

Transfers of helpers between crafts should be kept at a minimum as well as the temporary upgrading of men in the crafts and between the labor gang and the crafts.

Previous Situation

Prior to 1951 the M & C Dept. was a line organization devoted almost entirely to the execution of work. It was headed by a superintendent followed by an assistant superintendent to whom a single coordinating general mechanical foreman reported. Foremen in charge of the 15 different crafts reported to the general mechanical foreman.

The assistant superintendent handled field planning for project jobs and maintained liaison with the design and inspection sections of the Engineering Dept.

There were no clear-cut maintenance zones or areas except for minor maintenance jobs authorized by word of mouth and supervised by two coordinating zone foremen.

Manpower requirements were determined by craft foremen and reviewed by the general mechanical foreman, assistant superintendent and superintendent. The informal field planning was performed by the assistant superintendent, general mechanical foreman, and craft foremen.

In general, maintenance jobs were scheduled when and if they arose. Projects from the design section of the Engineering Dept. were scheduled to a limited extent when authorization to proceed had been received and when drawings or sketches and materials were available.

As the refinery grew and expanded, operations along the above lines became less and less effective.

Transition Period

The main problem in the reorganization was to obtain the proper balance between the execution and planning functions. It was necessary to define duties and responsibilities to give clear areas of authority, yet maintain cooperation and coordination between the execution and planning functions.

Organizing a scheduling system required considerable study of operations. All process unit shutdowns were incorporated into a master shutdown schedule. Ways and means were studied to schedule both project work involving capital investment and major repairs, and daily jobs.

One problem was to determine the proper size of staff to perform the scheduling function on a daily, weekly and long range basis. This was solved by the planning staff having both functions of planning and scheduling.

During the installing and operating of the new organization, four main premises essential to satisfactory performance were developed. They were:

1. Established process unit shutdown schedules should be adhered to within reason.
2. Conflicting priorities had to be resolved by a designated authority.
3. A proper year around balance between craft and labor gang personnel had to be maintained to meet fluctuating manpower requirements.
4. An adequate actual backlog of project work, ready to be started, had to be available to keep personnel gainfully employed between peak maintenance loads.

The Final Organization

The organization as finally established (Fig. one) is headed by a superintendent.

The assistant superintendent is specifically responsible for supervision and coordination of the execution function for maintenance and construction work performed by crafts in areas, zones and shops. Also, his position as relief for the superintendent requires that he be familiar with the planning and office functions.

The refinery is divided into two areas and three zones for execution of work. Area One—embracing Zones One and Three—is headed by an area general foreman. Zone One includes alkylation, isomerization, light oil treating and lubricating oil facilities, and is headed by a zone general foreman. Zone Three includes the catalytic and thermal cracking plant facilities, boiler houses, storehouse and salvage yard, and is headed by a zone general foreman and an assistant zone general foreman.

Area Two—with Zone Two only—covers widely separated segments covering a large geographical portion of the refinery. It includes light crude facilities, research and control laboratories, loading and shipping facilities, tank farms, a storage and wharf terminal three miles away, and a separate fuel oil storage and wharf terminal ten miles away. It is headed by an area general foreman and one zone general foreman.

Each zone is staffed by a maintenance assistant to plan maintenance and repair jobs not exceeding $1000 and authorized by zone operating personnel, a pipefitter foreman and machinist foreman to supervise routine maintenance work by their crafts in their zone, and a zone dispatcher to process Mechanical Job Orders (Fig. two) and perform filing and clerical work for the zone office.

Each zone has a small group of pipefitters and machinists to handle small single craft jobs planned within the zone and not processed through the Central Planning System. Their typical jobs include changing blinds, repairing pipe lines, packing pumps, and servicing equipment such as compressors, pumps, turbines, etc.

Area and zone general foremen are general supervisors in charge of the execution of all maintenance and construction work performed in their areas by refinery personnel and coordinating the work of various crafts through the craft foremen or lead mechanics assigned to the areas.

Where leadership in a given craft is not provided, the zone general foreman must either give direct supervision, or arrange for craft supervision from the shops or another job.

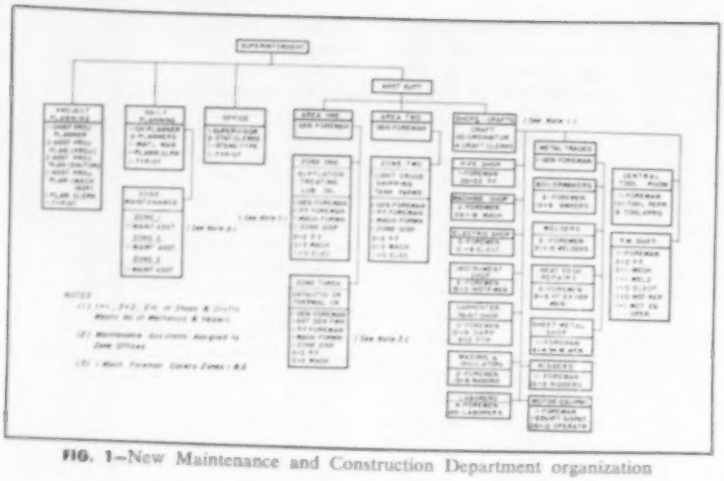


FIG. 1—New Maintenance and Construction Department organization

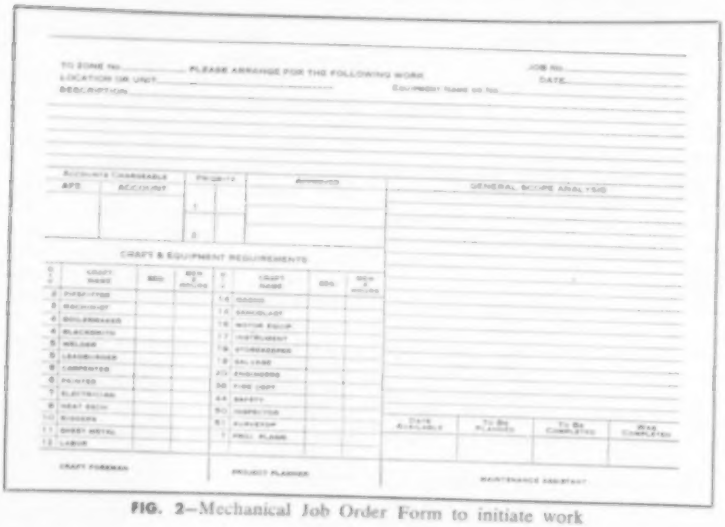


FIG. 2—Mechanical Job Order Form to initiate work

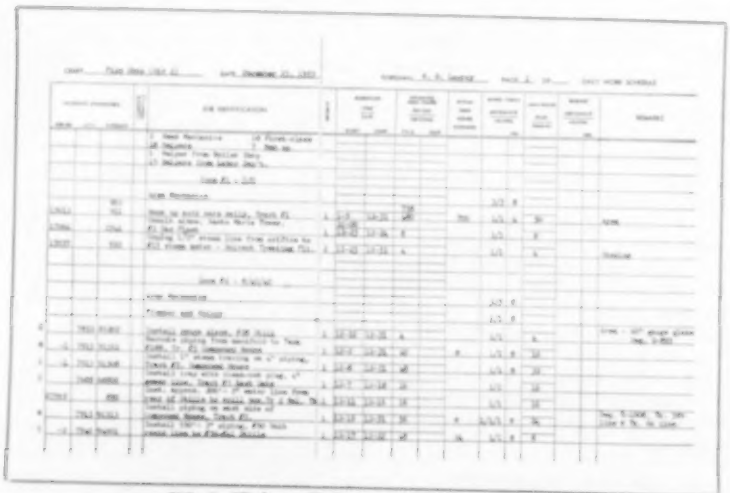


FIG. 3—"Balanced" Daily Work Schedule sheet

The intention of this supervisory set-up is that the area and zone general foremen give general supervision to coordinate the elements of the job —manpower, material, time, equipment availability, fire protection, and safety—while the craft foremen or leadman provide the "know-how" of their crafts to the job.

Fifteen divisions or crafts are in the Shops and Crafts set-up, under the supervision of a craft coordinator, as shown in Fig. 1. Each craft is headed by at least one foreman, most of them having one or more assistant foremen.

Additional coordinating craft supervision was provided for four crafts which work together closely—boilermakers, welders, heat exchanger repair men and sheet-metal workers—by heading them with a metal trades general foreman.

In addition to the permanent assignment of pipefitter and machinist supervision to each zone, a machinist foreman is on permanent assignment to the Machine Shop to supervise machinists operating lathes, drill presses, boring mills and the like. Supervisors in the other crafts go with the men and jobs in accordance with the Daily Work Schedule (Fig. 3).

A minimum crew under the supervision of a mechanical shift foreman covers the P.M. shifts Monday through Friday and days on Saturdays, Sundays, and holidays. Fig. 1 shows the crew size and distribution.

While planned work is assigned on these shifts, the men are available to work as necessary for emergency repair jobs. A great part of the pipefitters time is used changing blinds, and the motorized equipment crew operates a cleanup truck because operation on the day shift alone is insufficient to meet cleanup demands.

Allowing for unplanned personnel gives the planning system some flexibility to take up slack in meeting emergencies, handling repetitive routine minor repair jobs, and economically meeting variations appearing between the planning and the execution of a large number of daily jobs. A satisfactory balance between planned and unplanned personnel — keeping the latter to a minimum—was determined by trial and error.

The work of zone mechanics—pipefitters and machinists—is generally informally planned in the zones to which they are assigned. Some of the zone machinists, however, have their work planned through the Central Planning System with a formal preventive maintenance program for pump, compressor and turbine maintenance.

Personnel and heavy automotive equipment (crawler cranes, mobile

cranes, tractors, bulldozers and rigging trucks) from the motorized equipment division are planned together. Other vehicles are on scheduled service and planned, others are partially planned, and still others are unplanned and operate in immediate answer to written or telephoned requests.

Toolroom and janitorial personnel are unplanned.

It has been found expedient to leave the plumber and his helper and the operator for the pipe-cutting and threading machine also unplanned.

Table 1 shows the balance between planned and unplanned daily paid employes. Assuming all daily men present—no vacation, sick leave, or time off—planned personnel is 90% of total personnel.

Planning the Work

All maintenance and construction work planned through the Central Planning System is authorized in writing by the Mechanical Job Order form (Fig. 2). It is made in triplicate by persons authorized to initiate work requests. Original and duplicate copies enter the planning system, and the originator retains the third copy for his files. The original is such that after all entries have been made on it, it may be run off on a ditto machine for copies needed by shops, crafts and other interested parties.

Work authorizations are made along three general lines, as follows:

1. Maintenance and repair jobs whose aggregate cost—material, labor and overhead—is estimated at less than $1000 are authorized by department heads and operating superintendents through the Central Planning System to the zone offices. These are called zone maintenance and repair jobs.

2. All capital investment, dismantlement, and abandonment jobs and large maintenance and repair jobs—excluding major process unit shutdowns—of more than $1000 aggregate cost are authorized by the Engineering Dept. to the Project Planning Division of the M & C Dept. for processing through the Central Planning System. These are called project jobs.

3. Major process unit shutdowns.

The planning function embraces—whether performed in zones or the Project Planning Division—the following:

1. A general description of the work to be performed.

2. An estimate of the manhours required by each craft.

3. The craft sequence.

4. Special instruction and information to other departments.

5. Provision for material delivery to the site at the proper time.

6. The priority of the job.

7. The proper Accounts Chargeable.

8. Availability, planning and completion dates.

9. Drawings or sketches.

10. A time schedule for completion of craft sequences and material deliveries, particularly in the larger jobs.

Planners consult freely with area, zone and craft foremen to obtain realistic estimates of manhours and craft sequences. Data accumulated from repetitive jobs furnish standards for them. However, the bulk of the maintenance and construction jobs in a refinery is non-repetitive.

It is the essence of a planning system that job targets or goals be set and be known and understood by the persons who are to perform the work. Targets must be reasonable and practical to serve as an incentive for efficient work accomplishment.

Planning Zone Maintenance and Repair Jobs

Operating superintendents and department heads make out Mechanical Job Orders as discussed previously. The original and duplicate go to the zone office where the zone dispatcher assigns a job number and enters a description of the job in the zone log book. The original and duplicate copies are then given to the zone field planner—or maintenance assistant—for detailed planning of the job.

For No. 1 priorities, the "Date available" and the "Date to be completed" are made firm before the Me-

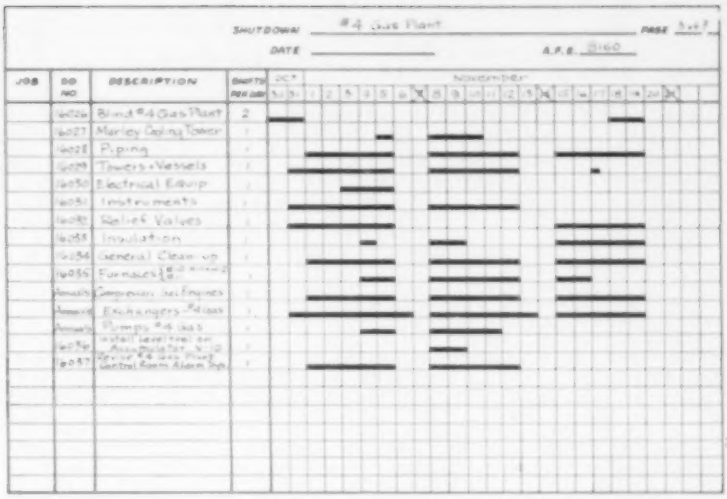


FIG. 4—Typical "Gantt" chart shut-down maintenance schedule

Table 1—Planned and Unplanned Maintenance and Construction Labor Balance

Shop or Craft	Total	Planned		Unplanned		
		Centrally	Zones	Shift	Shop	Special
Toolroom	6				6	
Janitors	4					4
Pipe	59	40	16		1	2
Machine	59	40	16		3	
Boilermakers	21	21				
Welders	36	36				
Carpenters	21	20			1	
Painters	8	8				
Electric	31	27	1		1	2
Heat Exch. Repair	14	14				
Riggers	18	18				
Sheetmetal	10	10				
Laborers	65	63				2
Masons & Concreters	21	21				
Instrument	21	17		2		2
Motorized Equipment	38	21		2		15
Total	432	356	33	4	12	27

chanical Job Order is sent to the Daily Planning Office for scheduling.

For No. 2 priorities, these two dates are subject to variation or negotiation between the zone field planner and the authorizing party. In fact, these dates may be left out, and the Mechanical Job Order routed to the Daily Planning Office to establish the dates based on available manpower and conflicting jobs carrying higher priorities.

Emergency jobs are those carrying top priority which must be processed and executed without formal planning. They are authorized on the regular Mechanical Job Order form with the word "Emergency" stamped across the original copy.

Project Jobs

These are authorized by the Engineering Dept. after receipt of management approval for expenditures. They include a detailed description of the work to be performed and the proper Accounts Chargeable.

The authorization is known as a Work Scheme and is accompanied by a detailed formal estimate giving the breakdown of labor, overhead and material for each item on the Work Scheme. The labor estimate is further broken down into the manhours required for each shop and craft. In addition the Engineering Dept. prepares and issues drawings and sketches and orders the material for the project.

The above information is forwarded to the Project Planning Office where the entire project and its component parts are planned in detail. Project planners prepare and issue to the Daily Planning Office the necessary Mechanical Job Orders for the performance of the work. These include drawings, sketches and materials available and are in accordance with the project priority and manpower availability.

Generally, project priorities are set to meet the estimated schedule of monthly expenditures appearing in the quarterly budget forecast. In special cases they are set by the refinery general manager or assistant general manager. Project jobs with high priorities may be established in order to meet the starting date of outside contract work.

Three project planners act as field engineers on project work performed by refinery personnel and follow assigned work in the field. They also maintain liaison between the M & C Dept. and Engineering Dept. personnel. Project planners may make recommendations from the field to the Engineering Dept., as major changes in project jobs are made only upon Engineering Dept. authorization — a procedure adopted to aid in controlling expenditures in the field.

Process Unit Shutdowns

A master shutdown schedule for all major processing units is prepared by the Project Planning Office for a period of approximately 12 months in advance. The schedule results from consultation with the Processing and Inspection Depts. and of M & C Dept. manpower availability.

The two project planners assigned to this function plan between 35 and 40 shutdowns per year. Shutdown lengths range between 3 and 30 calendar days, or in terms of shutdown maintenance between 2000 and 20,000 manhours — except the Fluid catalytic cracker shutdown would be a maximum of about 60,000 manhours. Smaller process unit shutdowns are planned in the zones by the zone maintenance assistants.

A minimum of four calendar weeks is required to plan a shutdown—even longer for the Fluid catalytic cracker. This is the interval between the preliminary shutdown meeting at which work lists are presented and the first day of the actual shutdown. This allows three weeks for planning and one week to brief shutdown personnel.

In case "pre-fab" jobs are required for the shutdown, the shutdown planner must issue Mechanical Job Orders for these as soon as possible.

Shutdown planners compare actual results with original job estimates or targets to establish standards. They also make use of:

1. Written work lists of all work items authorized by the operating superintendent based on his wishes, Inspection Dept. recommendations, etc.

2. Engineering Dept. authorization for projects to be done during the shutdown with the operating superintendent's approval.

3. A modified Gantt chart to schedule bottleneck jobs on the shutdown —see Fig. 4 for a gas plant shutdown schedule.

4. An over-all schedule of manpower by crafts for each day of the shutdown to guide the Daily Planning Office.

Shutdown planners follow the progress of the jobs and assist in procuring material. They process Mechanical Job Orders issued for additional work requested during the shutdown. They check on all actual versus estimated expenditures on the job to improve methods, reduce manhours and downtime, and correct future estimates.

A conference is held shortly after each shutdown to review the conduct of the shutdown. The shutdown foreman and craft foremen on the shutdown attend the conference with representatives of the Operating, Engineering, Inspection, Fire and Safety Depts. The project man planning the shutdown leads the discussion with visual aids in the form of charts and blackboard statistics.

The primary objectives of the conference are to analyze M & C Dept. operations during the shutdown, review procedures, compare actual results with targets, receive constructive criticism, and devise ways and means of improving future performance. These post-shutdown critiques have been found to be very effective.

Preventive Maintenance

One project planner has been assigned the responsibility for developing preventive maintenance and keeping equipment records. Programs now developed include compressors, pumps, turbines and blowers, and will extend to other equipment as studies are continued and records established.

The project planner plans in detail the overhaul of compressors and is closely associated with the refinery lubrication program, though direct responsibility for it has been assigned as a staff function to the process superintendent in the Operating Dept.

Scheduling the Work

The Daily Planning Division is responsible for the daily scheduling of work performed by the M & C Dept. This planning division consists of one chief daily planner, three daily planners and one material man assisted by one planning clerk and one typist.

One daily planner is assigned to each of the three zones, keeping a date file of Mechanical Job Orders originating in their respective zones. These date files also contain copies of Project Mechanical Job Orders from Project Planning with priorities and scheduled completion dates.

Since the planning functions for the daily planners and the project planners are interrelated, it is necessary here to describe how project jobs are scheduled.

Thursday of each week the project planners set target schedules for project jobs during the following week. While not a rigid schedule, it serves as a guide for the daily planners in fitting their zone maintenance jobs and project jobs together.

This target schedule is based on the number of men available from each craft for such work, considering:

1. Total in craft.

2. Estimates of absences from vacation, sickness, or leave of absence.

3. Requirements for shift and essential zone maintenance work.

4. Requirements for planned shutdowns.

Priority and progress of project jobs with respect to completion schedules are reviewed and a Weekly AFE or Project Schedule (AFE means "Authority for Expenditures") is issued. Following this, short meetings are held in each zone to discuss details of the schedule. They are attended by a project planner, a daily planner, the zone maintenance assistant and the area and zone general foremen.

It is necessary to have these weekly meetings with the above persons present due to the complex problem involving conflicting priorities and views.

The daily planners now have the Mechanical Job Orders coming from the zone maintenance assistants and project planners and the weekly AFE schedule as a guide to plan work for the following day. They also know the number of men available from each craft for planned work. The foreman in charge of each craft informs the daily planners as to the status of jobs carrying over from the day before and the manhours needed for completion.

With the above information, the daily planners are ready to "Balance the Plan" and prepare the Daily Work Schedule (Fig. 3) showing manpower available versus manpower required.

If a manpower deficiency exists, men may be upgraded temporarily from labor gang and helper status. If this is not sufficient, unplanned jobs must be deferred and the men used on planned jobs.

If a manpower surplus exists for a particular day, jobs may be pulled from the backlog date file to take up the slack. If the surplus in labor continues too long and the backlog of authorized work is depleted, a reduction in force is required, first from the crafts to the labor gang, and finally by lay-offs from the labor gang.

The plan is "Balanced" and a rough copy of the Daily Work Schedule completed by noon. Typists prepare the finished schedule on master ditto forms, and it is run off and distributed by 2 PM. This permits area, zone, and craft foremen to review them the remainder of the day.

As the Daily Work Schedule is being made firm during the morning, the material man in the same office arranges with the storehouse for delivery of materials to the job sites, at or before the time work is started.

Daily Work Schedule

A sample of the Daily Work Schedule as prepared by the daily planners is shown in Fig. 3. The sample shows the schedule for pipefitters in two of the three zones. A second sheet would be needed for the third zone.

Complete Daily Work Schedule sets for one day comprise 25 to 35 sheets and embrace job assignments and manpower for fourteen crafts for the three zones. Complete sets are distributed to all general supervisory, coordinating and planning personnel. Duplicate craft schedules are distributed to each of the shops and crafts.

Time and Labor Distribution

Time and Labor report sheets are forwarded in duplicate to each shop and craft. The left-hand one-third is the same as the Daily Work Schedule. The Accounts Chargeable and Job Identification columns are the same. The right-hand two-thirds of the sheet is for total manhours on each job and individual employe hours chargeable against the job.

Daily distribution of time and labor is made by each craft foreman or by his craft clerk and approved by him. The resulting report sheets are prepared in duplicate by each craft with total labor hours balanced against individual payroll time cards. One set of sheets is sent with the payroll time cards to the Accounting Dept., and one is retained by the M & C Dept. for statistical analysis and reference.

Backlog

A backlog of available work on project jobs is essential for all crafts to keep them gainfully employed between peak loads. This does not mean just budgeted jobs, but those for which drawings and sketches have been issued and materials are on hand. These are jobs on which field personnel may actually go to work. Such jobs may be capital expenditure, maintenance and repair, or a combination.

Three months' backlog was set as the desirable target for each craft in project jobs. A monthly control report is prepared by the M & C Dept. showing actual versus desired backlog for each craft. This monthly Project Backlog report is circulated to all interested departments, including Engineering which is responsible for project design and material procurement.

If the backlog drops below one and one-half months in any craft, the control report indicates this fact so that additional project work may be authorized and issued to the field. If the additional work is not forthcoming, then a reduction in force is necessary.

If the backlog builds up, either an increase in force is needed, or some of the work has to be performed by outside contractors.

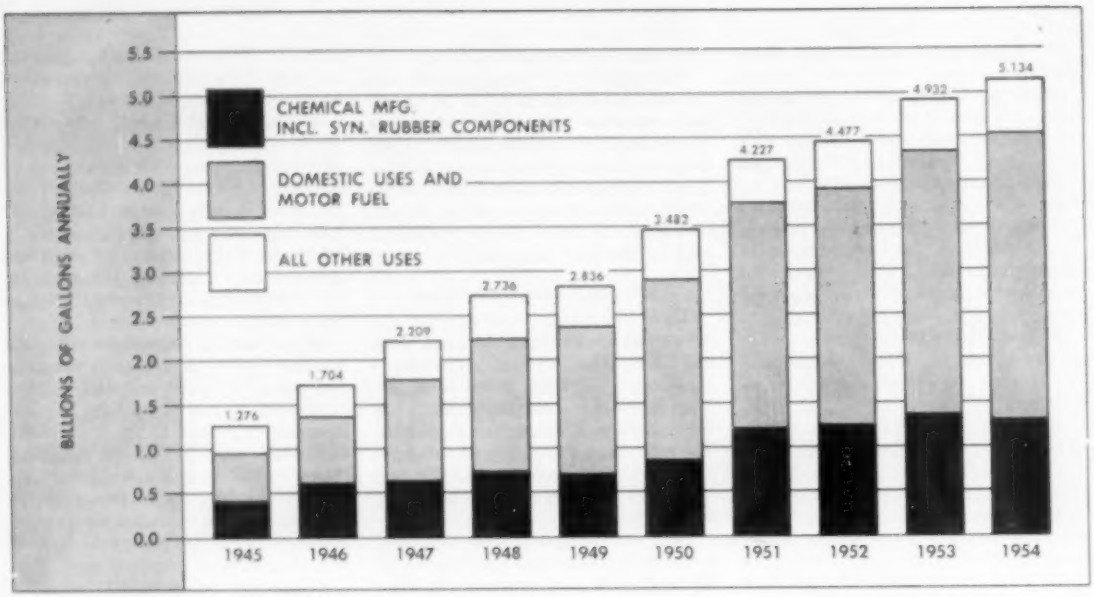
A separate report shows the Total Backlog of planned work in each craft for both project and zone maintenance work. It appears in Gantt chart form and shows the length of time for each craft to complete its authorized work under three categories of backlog:

1. Total.
2. No. 1 priority jobs with scheduled completion dates.
3. No. 2 priority jobs with variable or negotiated completion dates.

It has taken about three years to make the changeover, but the results achieved are encouraging, and even greater benefits are expected as the system is broadened and refined through experience. Time and patience are of course necessary factors.

Meet the Author

Mr. Creighton C. Carmine, Superintendent of Maintenance and Construction at the Avon, Calif., Refinery of the Tide Water Associated Oil Co., received a Bachelor of Naval Science degree from the U. S. Naval Academy in 1918, and a M.S. in Mathematical Physics from the University of Chicago in 1925. After 10 years as a Deck and Engineering Officer in the U. S. Navy, he resigned in 1928 to take a position as Mechanical Engineer at Associated Oil Co.'s Avon, Calif., Refinery. During 1930 he was Sales Engineer for Foxboro Co.'s Los Angeles office, and from 1930 to 1932 he was Sales and Process Engineer for the Jackson Engineering Corp. of Tulsa, Okla. He rejoined the Associated Oil Co. at their Avon, Calif., Refinery where he held positions of Mechanical Engineer, Foreman of Steam Production and Distribution—which he continued to hold after the 1936 merger into the Tide Water Associated Oil Co.—Office Assistant to the General Superintendent, Field Engineer in charge of field maintenance and construction, Mechanical Superintendent and finally his present position.



LARGEST GROWTH IN LPG was in domestic uses and in motor fuels, as shown in ten years of marketed production

Growth Rate Smaller but . . .

LPG Sales Continue Upswing

From a Report by GEORGE R. BENZ, PAUL W. TUCKER, and W. F. DeVOE, Phillips Petroleum Co.*

TOTAL sales of liquefied petroleum gas in 1954 were 5,134,000,000 gals., 4.1% higher than 1953 sales. Although this rate of growth is smaller than in many past years, it is still considerably ahead of the proportionate gain in demand for petroleum in 1954. And, the outlook for 1955 for LPG is for an even larger rate of growth.

Other highlights of the study of results of the year just past include:

- The largest single use-category—domestic and for motor fuel—was 3,250,000,000 gals. in sales, 9.2% greater than last year.
- Motor fuel use of LPG—while not catalogued separately—is estimated at 625,000,000, which is 25% larger than in 1953.
- Gas manufacturing or utility sales, and sales for the manufacture of synthetic rubber components, were down from last year. Sales for chemical manufacturing, and sales for industrial and miscellaneous uses increased moderately.
- Twenty new sources for LPG were completed or nearly completed in 1954, with the total potential production of over 700,000,000 gals.
- Total underground storage for LPG—in use, under construction, or proposed—by Jan. 1, 1955 was estimated at 708,000,000 gals., nearly 50% greater than on Jan. 1, 1954.

The largest segment of LPG sales is to the domestic and motor fuels market. It was gratifying to see the 9.2% increase here, to a total of 3.25 billion gals., while some other industries were noting a levelling off in their business. However, the shorter and milder 1953-54 winter served to limit the gain in sales in this use-category.

Summer sales did not hold up as well as in previous years due to the following reasons: The usually heavy irrigation load (fuel for the pumping units) did not start until late in the summer; and sales of LPG for tractor fuel were off due to the extreme drought, which sharply curtailed the use of tractors.

There has been a very substantial increase in the use of LPG for tobacco curing in some parts of the country. Small crop dehydration plants, as well as portable crop dehydration units, continue to be a good market. There is a growing and widespread interest in irrigation, running the gamut from truck gardening to major farm crops. However, house heating doubtless remains the biggest single potential loadbuilder. House heating with LPG is moving north. Heating in the cooler region calls for larger storage, both dealer and customer. The Liquefied Petroleum Gas Association (LPGA) is cooperating with the Civil Defense Groups in emergency mass food preparation demonstrations. It is becoming obvious that LPG will play a tremendous role in a national emergency.

Sales for motor fuel in 1954 showed exceptional gains over 1953. If they had been treated separately in this report, they would have exhibited the largest increase of any single use-category. It is very difficult to separate the quantity of LPG used as motor fuel from the over-all domestic use.

*This report, a statistical study of the liquefied petroleum gas industry, has become an annual service performed by one of the largest firms in this field. It has been prepared this year by George R. Benz, manager, engineering dept.; Paul W. Tucker, technical representative, engineering dept.; and W. F. DeVoe, assistant to the sales manager, sales dept.; Phillips Petroleum Co., Bartlesville, Okla.

Principal Uses of LPG, 1945-1954

Year	1000 Gallons	% Inc.	Domestic & Motor Fuel*	% Inc.	Indus. Misc.	% Inc.	Gas Mfg.	% Inc.	Chem. Mfg.	% Inc.	Rubber Compon.	% Inc.
1945	1,276,766	20.4	533,262	19.7	256,577	0.8	53,849	17.4	224,291	47.5	208,787	28.8
1946	1,704,262	33.5	758,466	42.2	253,745	— 1.1	86,660	61.0	311,499	38.8	293,892	40.8
1947	2,209,797	29.7	1,150,538	51.7	274,125	8.0	169,332	95.4	414,267	33.0	201,535	—31.4
1948	2,736,801	23.8	1,473,289	28.1	275,883	0.6	237,638	40.3	524,350	26.6	225,641	11.9
1949	2,836,599	3.6	1,627,550	10.5	247,103	—10.4	239,210	0.6	544,886	3.9	177,850	—21.1
1950	3,482,567	22.8	2,022,464	24.3	355,456	(1)	251,694	5.2	624,468	14.6	228,485	28.5
1951	4,227,275	21.4	2,456,804	21.6	269,408	(1)	281,692	11.9	844,507	35.2	374,854	64.1
1952	4,477,379	5.9	2,636,736	7.4	338,959	26.0	259,697	— 7.8	870,990	3.1	370,997	— 1.1
1953	4,932,009	10.2	2,977,418	12.9	374,233	1.04	222,430	—14.4	967,427	11.1	390,501	5.3
1954	5,134,000	4.1	3,250,000	9.2	382,000	2.0	208,000	— 6.5	977,000	1.0	317,000	—18.7

*Household use plus other requirements by these customers such as irrigation pumping, tractor fuel, flame weeding, chicken brooding and similar uses. Included also is LPG sold by domestic distributors but used for industrial purposes. Included also since 1950 is LPG sold direct by producers and marketers solely for fueling internal combustion engines.

(1) Not comparable due to change in method of reporting LPG sold for refueling internal combustion engines.

REMARKS: Total sales except for 1954 were obtained from Bureau of Mines data, also distribution for years 1931 to 1953. All other volumes are estimates by the authors of the report. The total sales volume includes all LPG (propane, butane and propane-butane mixtures) when sold as such. It does not include butane when blended with heavier petroleum fractions for motor gasoline purposes. Intercompany sales transactions, such as purchases of LPG by one company from other companies and resold as LPG have been eliminated.

NOTE: A direct comparison of 1954 LPG sales with those of 1953 reported by the Bureau of Mines indicates a substantial decrease for 1954. However, a change by the Bureau in the method of reporting LPG statistics starting Jan. 1, 1954 makes such a direct comparison of sales for these two years unrealistic.

However, it is conservatively estimated that the sales of LPG motor fuel increased 25% over last year.

This use alone amounted to nearly 625,000,000 gals., or over 12% of the total LPG sales. There are today more than 2500 buses, 200,000 tractors, and untold numbers of trucks and taxicabs operated on LPG. Service stations for this new road-vehicle fuel are becoming a familiar sight on some highways.

Outstanding during 1954 in the LPG motor fuel phase was the interest in converting industrial tractors and lift-trucks, and engines driving over-the-road cargo truck refrigeration units. Probably the most important factor in the conversion of lift trucks from other fuels to LPG operation is the elimination of exhaust fumes. With the refrigeration units, the major factors are the elimination of lead fouling of spark plugs and exhaust valve problems that resulted from using gasoline under constant speed, constant load conditions.

Industrial and miscellaneous sales of LPG totalled 382,000,000 gals., 2% over 1953 figures. It is estimated that because of natural gas pipeline extensions or increased pipeline throughputs, the industrial LPG load itself was down slightly from the previous year. This seems reasonable also when it is considered that one of the major industrial uses is in heat treating, an activity which levelled off last year.

However, the increase in miscellaneous applications more than offset the industrial loss. More industrial "stand-by" plants are being added as a protection against interrupted gas service with consequent shut-down and loss of production. One of the major railroads has stated that propane is an ideal fuel for the gas turbine type locomotive since practically no maintenance is required. However, the railroad does not yet contemplate using LPG as a fuel under present conditions of supply, storage and cost as compared with other fuels. The possible use of LPG for "flooding" oil sands to increase the recovery from low-pressure reservoirs containing viscous crudes is of considerable interest.

Gas manufacturing or utility use of LPG for 1954 is estimated to be about 208,000,000 gals., 6.5% less than in 1953. This was due to the mild winter and the natural gas pipe line extensions or increased throughputs. In some areas, the demand for LPG for peak shaving showed sizeable increases due to the utilities' taking on new house heating loads. The use of LPG "in the mains" at new housing developments continues to be very popular.

Uses for chemical manufacture and for chemical intermediates showed only a modest increase of 1% over 1953, with an estimated 1954 volume of 977,000,000 gals. This increase was brought about by an upturn in demand during the final quarter.

Petrochemicals made a much greater gain during the year—as a group within chemicals—but most of the gain was due to increased use of methane and ethane in the production of anhydrous ammonia and polyethylene. Petrochemicals used in the textile industry, many of which are produced from LPG, had a slow year. The market for synthetic alcohols and various anti-freeze compounds, also large consumers of LPG, likewise was weak. These decreases were slightly more than compensated for by the requirements of new plants and full-time operation of plants built in 1953.

Manufacture of synthetic rubber components in 1954 took about 18% less LPG than in 1953. The total 1954 volume is estimated at 317,000,000 gals. This reduction resulted from the substantial cutback in synthetic rubber production authorized by the Federal Facilities Corp. (formerly the Reconstruction Finance Corp., Office of Synthetic Rubber). Reductions in the synthetic rubber program were due to a combination of several factors.

The high production of automobiles during 1952 and 1953 had resulted in a considerably higher number of new cars on the road than had been regarded as normal in previous years. These cars, for the most part, are still running on their original rubber today and this has affected adversely the demand for replacement tires.

Tire mileage has increased over that attained during the past few years due to improved synthetic rubbers and better carbon blacks. The greater use of natural rubber (due to a softening of the natural rubber market) and the reduction in new car tire demands as a result of the 1954 cutbacks in auto-

Underground Storage for LPG

(1,000,000 gals.)

	Jan. 1 1954	Jan. 1 1955
Storage in Use:		
Caverns in salt formations	212.1	383.1
Mined caverns	16.9	27.8
Storage in sand formations*	17.0	47.5
Total storage in use	246.0	458.4
Storage Under Construction:		
Caverns in salt formations	93.9	132.9
Mined caverns	15.8	7.6
Total storage under construction	109.7	140.5
New Storage Proposed:		
Caverns in salt formations	99.7	92.6
Mined caverns	20.2	16.8
Total new storage proposed	119.9	109.4
Total Storage:		
(In use, building and proposed)		
Caverns in salt formations	405.7	608.6
Mined caverns	52.9	52.2
Storage in sand formations*	17.0	47.5
Total	475.6	708.3

*Capacities of storage in sand formations are reported as the maximum volume used thus far, since the ultimate capacity is unknown.

mobile production were also factors in reducing total rubber requirements.

What about LPG supply? The production potential continues to increase despite curtailment in crude oil production and crude runs to stills at refineries. Twenty new sources of LPG were completed or nearly finished in 1954, with a total production potential of over 700,000,000 gals.

These included 19 natural gasoline plants and one major refinery addition. This increased capacity was not available for the entire year of 1954, because some of the larger sources were completed near the end of the year.

It is estimated that 15 new plants will be added in 1955 with a production potential of upwards of 200,000,000 gals. The production capacity is available to satisfy large increases in demands.

An adverse effect to the LPG business is clearly seen in the recently imposed regulation of independent natural gas producers, unless Congress acts to remove this regulation.

Natural gas is just one of the energy products of the petroleum industry which, along with LPG and refined products, compete with each other. About one-third of the natural gas is produced with oil from the same wells. LPG comes from natural gasoline plants which process the wet gas to remove the liquids and from refineries processing crude oil.

Any regulation which adversely affects the production and marketing of any of these products—all of which share in the cost of exploration, development, and production—will tend to increase the cost and decrease the supply of the others. If the cost of LPG is increased and its supply decreased below market demand level, its competitive position with respect to coal, electricity, and other energy sources is endangered.

Natural gas was sold at distress prices for years before the tremendous increase in demand of the past few years occurred. Over the long term, competitive demand will be the only factor which will cause natural gas to adjust to proper price levels in relation to other fuels. A natural gas price artificially depressed by regulatory forces—which may well occur in many areas during the first several years under regulation—will place the LPG marketer at a competitive disadvantage.

And perhaps of most importance, such control will directly or indirectly lead to regulation not only of natural gas but of the rest of the products of the petroleum business, including LPG.

Storage facilities for LPG are at an all-time high. Storage has been increased at all levels—producing, distributing, and consuming. The industry in 1954 continued the rapid development of underground facilities. The 458,000,000 gals. of underground storage in use at the end of 1954 exceeded storage in use a year earlier by 212,000,000 gals., a gain of approximately 86%. And, at year's end an additional 250,000,000 gals. of storage was under construction or proposed, as shown in an accompanying table.

Most of the storage developed and proposed is situated in salt formations in gas producing areas. The industry has taken advantage of lower construction costs for such storage facilities in the vast Permian salt beds, extending from central Kansas through the Oklahoma and Texas Panhandles, across west Texas and southern New Mexico; and in the numerous salt domes along the Gulf Coast in southern Louisiana and Texas. Some use has been made of storage space in sand formations underlying many producing facilities. The underground storage in use east of the Mississippi and generally north of the Mason-Dixon Line totals approximately 34,000,000 gals.

In recent months construction has started and plans are being made for additional underground storage at refineries and terminals along the East Coast and in the eastern part of the United States. The trend toward underground LPG storage in the northeast has been slow in developing, but it may be expected to expand. However, the total storage of this type foreseen for this important distributing area is less than 10% of the total underground storage.

And transportation? An estimated total of 26,000 pressure tank cars now in service are suitable for handling LPG. However, about 7500 of these cars are in other services, principally chemical, leaving an estimated 18,500 cars in LPG service. Over 2100 new tank cars were added to the LPG fleet during 1954. Another sea-going barge was christened and put into service this year. This makes a total LPG water fleet of two ships, three dual-cargo ships, four propane barges (two for inland waterways and two sea-going), and one butane barge.

While a substantial amount of the total LPG is currently being moved by pipeline, new pipeline projects have been announced for Mexico, Canada, and the U. S. Truck movement is increasing too, with the trend toward the use of large "blimp type" or single-barrel, cargo trucks instead of the twin-barrel units, because of increased payload.

LPG sales for export are up again in 1954 about 30%, totalling 38,500,000 gals. New extraction facilities have been proposed for Canada, Mexico, and England but are not yet in operation. These plants may affect the export market. However, the demand is on the upswing, and the foreign LPG market is bright.

FAILURES IN ONLY SIX MONTHS in these coating jobs. At left, blisters caused by mill-scale on new steel; right, pits beneath scale

Cheap Painting Is No Bargain

By ***WARREN D. PALMER***
Houston, Texas

CRIME does not pay—if the crime is to skimp on protective coatings for plant equipment structures. Substandard coatings using inferior materials and improper application methods will frequently cause excessive maintenance and replacement cost. And, unfortunately, it is often impossible or impractical to make a satisfactory repair or replacement job once the substandard coating has been applied. A "cheap" coating material is not a bargain, its first cost being almost as great as that of an adequate coating using proper materials.

Four prime factors are necessary to get and keep a good protective coating on plant equipment, be it in a refinery, chemical plant, power plant, or factory:

1—Preparation of surface to be coated.

2—Selection of proper coating material.

3—Correct application of coating.

4—Maintenance and protection of coating.

It is much easier and cheaper to follow these four factors carefully and do the job correctly at the beginning than it is to try to correct it later.

1—Surface preparation

Proper surface preparation may be the most expensive step in any coating program and the most important. It is in this step where many unwise short-cut methods are tried with disappointing results. If inadequate, the coatings applied subsequently will be doomed to costly and premature failure. See photographs above.

A clean surface is necessary for any protective coating to give its best performance, regardless of advertising claims. The metal—or other—surface must be free from mill scale, mill scale binder, rust, dirt, oil or any foreign material which will disrupt or weaken the coating bond.

Sandblasting is usually the most economical and practical surface cleaning method. Blasting sand should be purchased by specifications for purity (fresh water washed, minimum clay), anchor-pattern desired, cutting speed, cost, and minimum dust fog during blasting.

Fine or medium (15 to 35 mesh) silica sand is preferred for blasting. It produces an even anchor-pattern of 1 to 2 mils between peak and valley. Finer grain sizes produce more cuts per unit time when using normal air pressure. Shallower anchor-patterns are produced with any size sand when using lower air pressure. However, the grain size should be related to the job. A large particle and a hard blow may be needed to break or cut the scale and remove surface contamination.

Unscreened sand, such as most river sand, contains a large portion of fines which produce little cutting action and excessive dust fog, resulting in increased cleaning costs and a dirty yard condition. Clay, silt and minerals present in such sands imbed in the anchor-pattern producing a surface unacceptable for painting. Moisture in the sand, or air, may deposit a film over the prepared surface, preventing immediate painting.

If blasting is done near painting provide enough room in the yard and schedule operations so that sand will not settle on and ruin the freshly primed or painted surfaces. If handling is not a problem, it may be advisable to follow the sandblast with a protective wash-primer, then transfer the material to another area for priming.

Pickling facilities for removing mill-scale at the job-site should be considered when large quantities are involved. This arrangement can cut the cost of surface preparation up to 10 or 15¢ per sq. ft. of treated surface.

For smaller quantities, the steel should be routed through a pickling plant enroute to the fabricator or the painting yard. Steel so treated probably will rust slightly before reaching the painting yard, but this fine dust is easily removed by light sandblasting.

Vinyl butyral wash-primers are useful in localities such as the Gulf Coast where high humidity and frequent rainfall prevail. Formulations generally contain phosphoric acid and an alcohol. The phosphoric acid etches the steel, reacting with small particles of rust which still remain in the pits of the anchor-pattern. The alcohol removes surface moisture as it evaporates. The remaining thin vinyl coating gives good short-time surface protection preceding the first prime coat.

Wash-primers may be brushed or sprayed—a wet coat being essential. Brush application is recommended after removal of sand from the freshly blasted surface, as it insures a wet coat and a washing action to free fine dust from the metal surface. Drying time is rapid, ranging from 20 minutes to an hour. After two hours drying, the first prime coat may be applied.

Tank surfaces have been protected by such wash-primers for up to 30 days during damp rainy periods with

a minimum of reblasting before applying the first prime coat.

Wash-primers are not considered a paint coating, but as a part of the blasting and surface preparation. They protect newly cleaned surfaces until the first prime coat is given. They remove fine dust, moisture, slight rust pits and minimize reblasting if bad weather intervenes. Wash-primers also improve adhesion and minimize "coating creep", but are not recommended for surfaces above 300° F.

A central location for sandblasting and inspection operations permits a qualified inspector to examine and supervise all work, workmanship and materials used.

The inspector should maintain adequate records on the paint history of all components including manhours and material costs. A working form useful for this purpose is shown in the accompanying sketch. Too many plants have no exact information on coating application and maintenance costs, and their inspection is frequently inadequate.

All blasted surfaces must be dry and free from oil, grease, dirt and other contaminants, including weld-spatter, before applying either a wash-primer or the first prime coat. The inspector's magnifying glass, litmus paper, and moisture tests will indicate quickly whether or not the surface is ready for painting.

2—Coating Selection

It is not always easy to select the best coating for a given service. Often the information is not available from previous applications, and time is too limited to allow performance evaluations.

Familiarity with the general plant environment and local atmospheric conditions are necessary before preparing coating material specifications. Process materials and conditions must be known. Screening the recommended paint formulations can be expedited by preparing small panels and exposing them to spillage, immersion tests and contact with fumes.

Paint manufacturers' sales engineers are qualified and willing to point out the limitations of their various formulations. A failure is as disagreeable to them as to the buyer. These representatives are anxious to observe application methods to assure themselves that their product is being used in such a way as to give maximum performance. Local coating manufacturers usually are found to be more interested in a plant's specific problems than those having facilities further away.

Table 1—Painting costs for alkyd enamel coatings: ¢/sq. ft.

	First Class Painting	"Economy" Painting	"Economy" Savings
Labor			
Surface preparation	25[1][3]	15[2]	10
First red lead prime coat	6	6	0
Cleaning and spot priming	4	0	4
Second red lead prime coat	5	0	5
Intermediate prime coat	5	5	0
Two enamel finish coats	10	10	0
Supervision, inspection, etc.[3]	6 to 8	0	8
Materials (prime & enamel)	15 to 20	11.5 to 16.5	3.5
Total costs	76[4] to 83	40.5 to 52.5	30.5

(1) Includes labor, equipment, sand, and wash-primer.
(2) Unsuitable method.
(3) Includes also job specifications and job history for First Class job. For "Economy" job, all control is by the construction engineer.
(4) Labor costs are for brush application of all coats. Subtract 5¢ from above if prime coats applied by brush and others by spray.

Regular formulations produced under strict composition and quality control are to be preferred to on-the-job mixtures prepared by the applicator. From these, field records keyed to the manufacturer and his product code number will give performance data of value to both the manufacturer and the plant personnel.

Inferior materials will not save very much in the overall cost of the job,. The cost of coating materials will average around 25% of the total coating cost no matter what the quality.

Screen the recommendations of the paint manufacturers' sales engineers or employ a paint engineer familiar with the specific job requirements to avoid inferior or unsuitable materials.

3—Coating Application

Skilled and constant inspection is the only way to be certain that all surface preparation and coating specifications have been followed. Too often this vital job is assigned to the plant engineering department of the corrosion engineer in *addition* to normal duties. This *precludes* the necessary constant supervision.

One plant engineer's experience with a fabricator illustrates this point. The fabricator was required to prime the surface prior to delivery at the job-site. When the engineer visited the fabricator, he found primer being applied in the rain on surfaces which had rusted lightly between blasting and priming. The foreman on the job explained that the rain-pitted coating would be "covered up when we apply the second prime coat."

All coating applicators aren't negligent, and it is just as much the inspector's job to protect the applicators from unreasonable demands and sudden changes as it is to see that they follow specifications. Actually, most applicators welcome a fair-minded, intelligent inspector.

The first prime coat for synthetic alkyd type enamels—which will be the only type covered in this article to simplify the discussion*—usually is a red lead-zinc chromate type, or a red lead—red oxide type primer which dries for recoat in 4 to 12 hrs. This is a good choice if the metal surface has been thoroughly cleaned and wash-primed.

Minimum wetting is necessary and brush application is preferred to provide ample coverage to the anchor-pattern peaks. The prime coat should be highly resistant to abrasion and mechanical damage and a dry thickness of at least one mil is required.

Second prime coat application can wait up to 30 days, and generally is applied after erection. A 12 to 48-hr. drying formulation is recommended for the second prime coat. It should be applied following removal of weld spatter and slag, and spot priming portions of the first prime coat damaged during handling or erection.

The second prime should have a dry film thickness sufficient to bring the total passivating prime coat to a thickness of from 2 to 2½ mils.

The intermediate prime coat (iron oxide type) is applied after erection and spot touch-up of the first and second prime coats. The primary purpose is to build protective coating film and provide flexibility. It can be

* Similar requirements but special considerations apply to such coating materials as the vinyl, Epon, neoprene, and similar types.

brushed on, or sprayed. A drying time of 12 to 48 hours is recommended, and it should have a dry film thickness of 1 to 1½ mils.

Finish, or color, coats are used to provide complete hiding and adequate film thickness. Usually two color coats are required and generally they dry hard overnight. Care should be exercised to choose colors which are stable in the plant environment.

When using alkyd enamel on flat surfaces, the minimum total dry film thickness for prime and finish coats should be 5 mils to provide adequate protection in the Gulf Coast region. Individual coat thicknesses should be specified in practice to give a 6-mil total thickness, to allow a margin for minor variations. The finish coat is usually specified at two coats with a minimum of 1 mil dry film thickness per coat.

If the conditions to be resisted are severe, and if other materials are used, the total coating thickness required may range up to 10 or 20 mils dry film.

Testing for "holidays" should be made following the application of the third coat, or before the application of the two finish coats. Electrical holiday detectors are available for this purpose.

Numerous plants, among them petroleum refineries and chemical plants, have adopted safety color codes and piping codes to identify contents and other bright color combinations, along with conventional black and aluminum shades resulting in a beautiful, pleasing and functional combination.

Contamination between coatings can be prevented only by adequate supervision and scheduling of work. Requiring inspection is the best assurance that the surface is clean and free of foreign materials, that damage to previous coats has been repaired and that the surface is dry before additional coats are applied.

Since different units and equipment items are exposed to different environments, the general painting specification should be supplemented by suppliers' technical recommendations and the "paint and color schedule." This latter lists the item, functional number, description and details the surface preparation, materials, number of coats, and application of coats from prime to finish.

4—Coating Protection

Damage to coatings during construction is not uncommon. It can be handled in only one way: proper scheduling between painting and construction or operations requirements.

It is not uncommon to see new construction being painted and the paint wiped off nearly as fast as it is applied by other crafts in climbing to and performing their work. Such a condition not only ruins the paint job, but is a safety and fire hazard.

Abuse of coatings can be minimized by plant management policies. Coating damage through accidental spills and splashes can be reduced by initial proper selection of the finish coatings. Sometimes the equipment must be designed with this possibility in mind. In any case, however, the best solution is to quickly wipe up the spill or splash.

Maintaining a coating requires constant vigilance. Damage should be repaired as soon as noted to prevent corrosion from burrowing under the remaining paint film. Repair materials should be carefully selected and properly used. If the original surface preparation was made in accordance with specifications, repairs are quicker and maintenance requirements fewer.

Costs for a good paint job are always uppermost in the user's mind. However, surface preparation and painting prices vary, depending upon specifications, coating type, working conditions, bad weather down-time, and job location. Cost estimates vary so much that they usually are not quoted in dollars and cents in the literature. More complete information on this subject may be found in "Good Painting Practice."(1)

Table 1 gives approximate comparison figures for the various painting operations to give a First Class job and to give the average "Economy" job. They are based on contract work where the contractor furnishes everything but the paint. The figures include labor, equipment, scaffolding, air and sand, insurance and the usual allowance for overhead and profit with best conditions assumed.

When the potential user adds these figures and finds that it will cost him from 71 to 83¢ per sq. ft., the usual reaction is to say, "That's entirely too much. We can't afford it."

Sandblasting is the first item to get the ax. Some of the rust and dirt is removed by hand. Red lead primer is smeared—or worse yet, sprayed—over mill scale and the remaining rust and dirt. For this alleged surface preparation the customer saves 10 or 15¢ per sq. ft.

The remaining operations are similar to the first class job except that the second prime coat is eliminated giving a three-coat covering and saving about 8.5¢ per sq. ft.

Last, but not least, on the ax list is the elimination of all supervision and control except for a little that the construction engineer or plant engineering department might or might not offer. Paint history and cost data are non-existant. No one knows whether or not specifications have been properly followed. This reduces expenses to that shown in the "Economy" column of Table 1.

While coating costs have been reduced by about 30.5¢ per sq. ft., mostly by skimping in the preparation and prime steps, the result is to spend 52 of 53¢ per sq. ft. mopping good paint over an unsound surface. In as little as three months, and often within six months, the entire coating could fail and the 52 or 53¢ would become a total loss.

Recoating is difficult as it is often impossible or impractical to sandblast within the operation area once the structure and vessels are completed due to damage to nearby equipment or the loss of a process shutdown. Handscraping is unsatisfactory and will lead to a repeat of the previous failure.

The moral is do it right the first time. There might never be another chance.

The best painting specifications, plus the best protective coating materials may be furnished. But their effectiveness and the results depend upon the supervision, inspection and control of the application by experienced, qualified and dependable personnel.

Reference

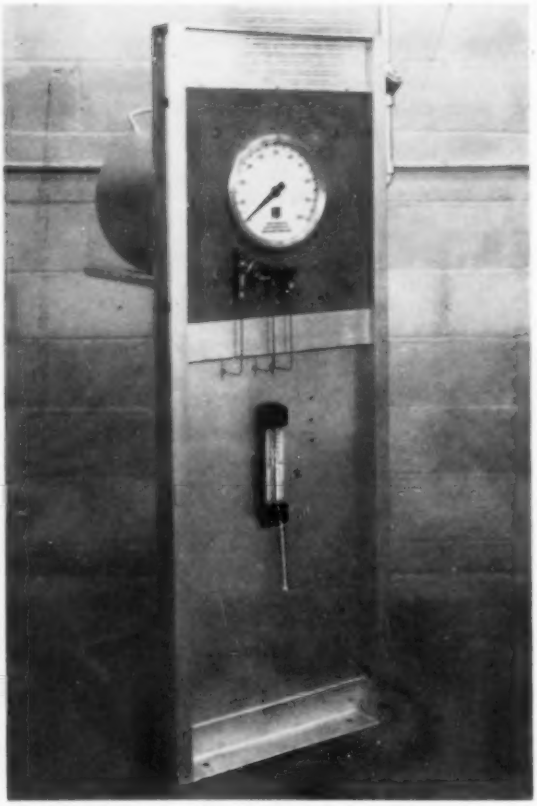
(1) "Good Painting Practice," Vol. 1, p. 379, Economics Considerations, 1954, The Structural Steel Painting Council, 4400 Fifth Ave., Pittsburgh 13, Pa.

Meet the Author

For the past seven years, Warren D. Palmer has specialized in the field of corrosion fighting by means of paints and protective coatings. Born in Arkansas City, Kans., he received his schooling at Kansas State College, Manhattan, Kans.

Subsequently he was a field engineer on construction projects for The Austin Co. and for Ford, Bacon & Davis. In 1942, Mr. Palmer joined Monsanto Chemical Co. at its Texas City, Texas, plant. For the last six years of his service at Monsanto, he was an inspector and protective coating engineer in the corrosion and engineering section. He resigned from that job early in 1954 to establish his own consulting firm, Protective Coating Engineering & Inspection Service, in Houston.

INFRARED ANALYZER as installed at a process unit in a weather-protective housing



DIFFERENTIAL REFRACTOMETER assembled and ready for installation in the plant

Are Process Analyzers for You?

Here's how two types work and are used by Phillips—who like, build and use them

By D. P. THORNTON, Jr.
Southwestern Editor

TWO analytical type control instruments have been developed by Phillips Petroleum Co. for automatic process control or indication and recording applications following several years of experimentation and successful plant trials. Both types are now in routine use at several of the company's plants and a few have been made available for other oil companies. They are now available to industry generally.

One is an infrared analyzer of high sensitivity, stability and of rugged construction.

The other is a differential refractometer, equally-rugged.

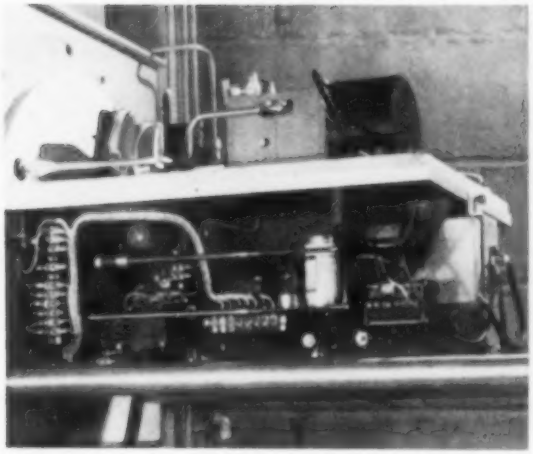
The accuracies of these two instruments, in the plant, is high and comparable to the accuracy obtained from similar laboratory equipment.

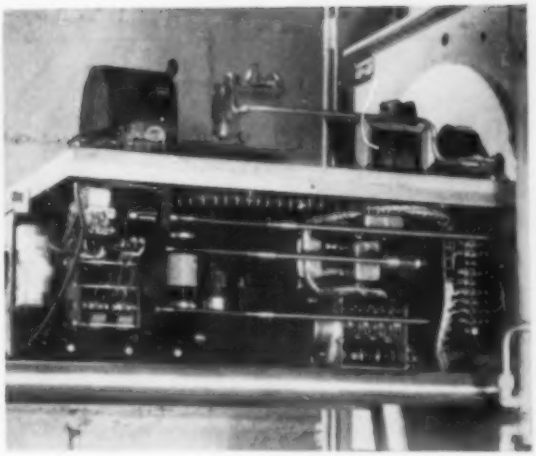
Analytical instruments are by no means new, either to the chemical or oil industries. They are most commonly found in the laboratory, however, and where associated with plant units—generally petrochemical processing—they usually function as an indicator of product quality of certain plant streams.

One of the big headaches of modern instrumentation, time-lag, can be virtually eliminated by using continuous stream analysis for direct process. Unfortunately, where interval-sampling is practiced and regardless of the analytical method used, there always will be a lapse of time between the instant of sampling and when analytical data becomes available. In that period of time, process variables may well have wandered considerably from conditions prevailing when sampling occurred but, even if they have not, any corrections necessary can only be made on a stepwise basis.

On the other hand, with continuous analyzer control via an override or cascade arrangement to the conventional control instruments regulating secondary variables, the time lag is reduced to a minimum between sampling and corrective action based on analytical results.

This is true even in cases where manual resetting of some conventional control in response to analyzer indi-





INFRARED UNIT INTERNALS: left: amplifier in lower section and mirrors, cells, and bridge in top section. Right: control circuits, slave-timers in lower section and infrared source and source transformer above

cation is the method of choice. The accuracy and speed of response of the indication or control function is principally dependent upon the care used in selecting the "key component" for analysis, the sampling point chosen and the thought given to the design and maintenance of the sampling system.

Even less common than infrared and ultraviolet spectrometers are instruments continuously measuring refractive index for process control. Most of the devices which have been described use glass as a refractive index reference standard and, although they record, are not known to have been used outside of the laboratory.

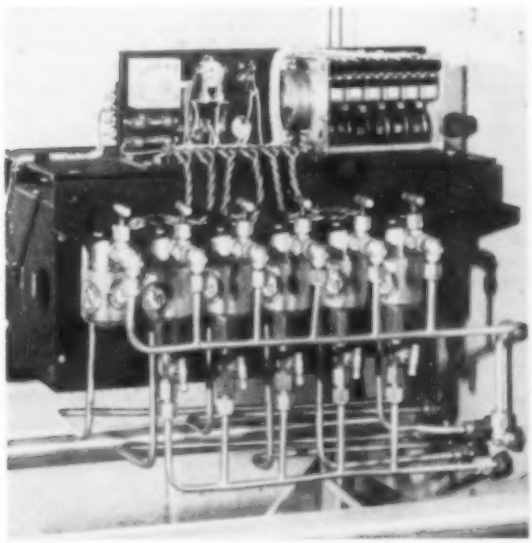
Often, refractive index per se is not a trade specification which the product must meet. Nevertheless, it is a characteristic of the product and, in hydrocarbon streams, usually suffers a proportionately greater change than boiling point, especially if the system is not a binary mixture. Even if refractive index is not directly related to product quality, it frequently can be used in control by correlating it sufficiently with specification requirements.

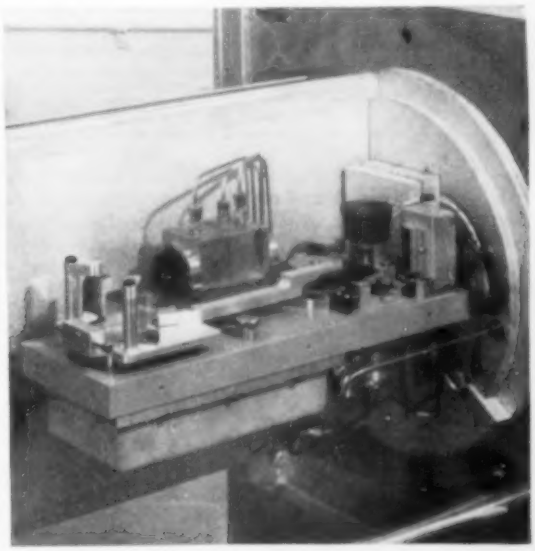
An advantage frequently used in process control applications is the non-specific character of refractive index. Complex multi-component streams may at times be viewed as a simple binary mixture by a refractometer, when more specific methods of analysis are rendered useless by mutual interference of components. This is especially true when the desired measurement is the difference between classes of compounds, such as paraffins from naphthenes or naphthenes from aromatics.

Refractometers and spectrometers have been found to be complimentary instruments. In general the fundamental characteristics of the application itself dictates the instrument and little if any competition between the two exists.

Infrared Analyzer

The optical system of the infrared analyzer is that of a double beam filter photometer. It consists of an infrared source, a sample cell com-





SAMPLE MANIFOLD for infrared analyzer, with power supply and cycle timers, is housed in separate explosion-proof case

REFRACTOMETER INTERNALS: Components visible are same as shown schematically in Fig. 5: others behind vertical plate

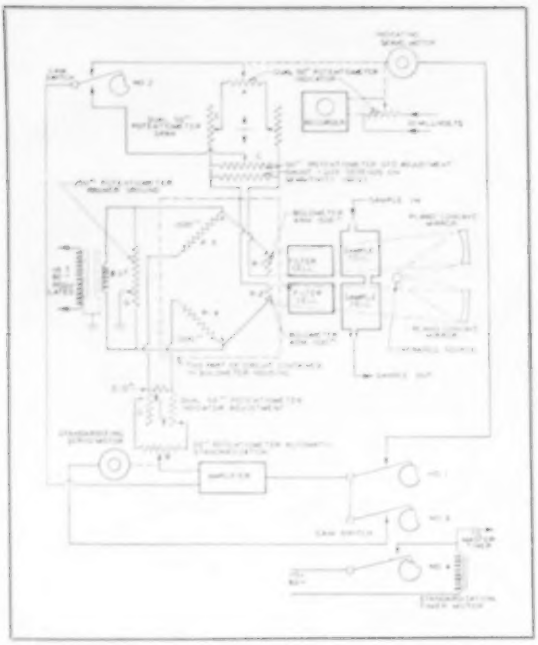


FIG. 1—Simplified schematic arrangement of the automatic infrared analyzer

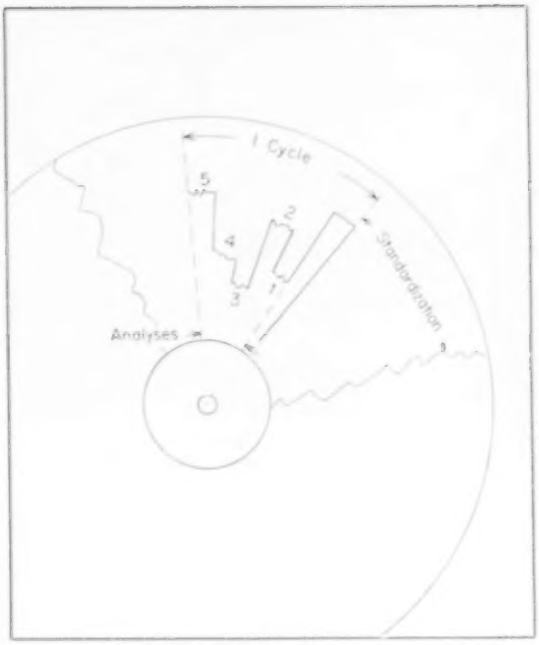


FIG. 2—Typical 5-stream analyzer chart record

mon to both beams, two individual filter cells, and two bolometers to measure the intensity of radiation in each beam. Two collimating mirrors split source radiation into two beams.

The system is sensitized to a desired component by filling one filter cell with a pure sample of that substance. The second filter cell is filled with a non-absorber which may include some special material to reduce the interference of other compounds in the sample. Often solid optical filters, such as quartz, sapphire, spinel, and the like, aid in sensitization.

The filter cell filled with the desired component removes by absorption most of the radiation in its beam common to this gas, thus desensitizing this beam to variations of the component in the sample cell. The radiation in the other beam varies with the changes of the desired component in the sample cell. Since both beams see variations in all other compounds similarly, the resultant difference in radiation, as measured by the bolometers, is proportional to the desired component. An opaque flag is used to balance the total radiation impinging on the bolometers.

The bolometers which sense the intensity of the radiation in each beam are an integral part of the electrical section of the instrument. They act as transducers, converting radiation into a proportional electrical signal suitable for amplification.

A diagram of the analyzing circuitry is shown in Fig. 1. It will be seen that the two bolometers, which are merely resistors with a high thermal coefficient, form two legs of the familiar Wheatstone bridge. Since the resistance of each bolometer is proportional to its temperature, an unequal infrared radiation intensity in the two beams unbalances the bridge.

The analyzing bridge is unlike the conventional Wheatstone bridge in several respects, however, in that provisions for zeroing the indicator, changing the range (resistance transfer), and automatic zero standardization are provided along with automatic bridge balancing. An alternating bridge excitation voltage is impressed across points *R* and *S* while the degree of unbalance is sensed between points *A* and *B*. The direction of unbalance between the two bolometers is sensed by the phase relationship of the amplifier input signal with respect to the excitation voltage.

The servo system, including the amplifier, is phase sensitive and automatically drives the indicator poten-

Table 1—Comparison of Phillips Infrared Analyzer Data With Low Temperature Fractional Analysis

"Spot 111"—Depropanizer Bottoms (% Isobutane in Recycle)				"Spot 118"—Debutanizer Overhead (% Isobutane in n-Butane to Storage)			
Date	Phillips Infrared	Laboratory Analysis	Diff.	Date	Phillips Infrared	Laboratory Analysis	Diff.
4/2	85.1	85.0	−0.1	4/2	3.2	4.0	+0.8
4/5	88.8	88.5	−0.3	4/5	4.0	4.0	0.0
4/7	87.1	87.0	−0.1	4/7	3.5	3.9	+0.4
4/9	89.7	90.0	+0.3	4/9	2.0	1.5	−0.5
4/12	90.4	88.5	−1.9	4/12	3.5	3.5	0.0
4/14	92.3	93.0	+0.7	4/14	6.5	6.8	+0.3
4/16	90.1	88.5	−1.6	4/16	3.5	6.0	+2.5*
4/19	87.4	87.5	+0.1	4/19	2.5	2.7	+0.2
4/21	90.0	88.5	−1.5	4/21	3.0	3.2	+0.2
4/23	87.1	86.5	−0.6	4/23	2.5	2.8	+0.3
4/26	88.7	87.5	−1.2	4/26	2.5	2.7	+0.2
4/28	80.1	81.5	+1.4	4/28	2.0	2.8	+0.8
4/30	79.1	80.0	+0.9	4/30	1.5	1.3	−0.2

* Instrument adjusted on this date.

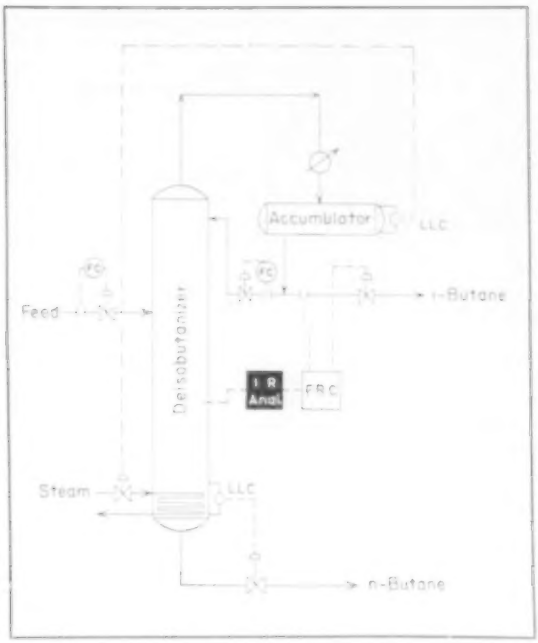


FIG. 3—Infrared analyzer in control of a butane splitter by cascade arrangement

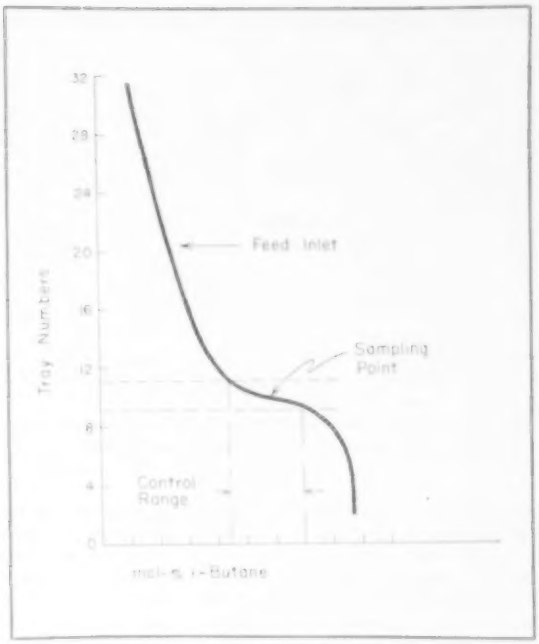


FIG. 4—Composition profile of butane splitter for infrared analyzer control

tiometer toward the balance position to compensate for bolometer changes. These changes are proportional to the concentration of the component in the sample to which the optical system is sensitized.

For remote indication or control purposes a telemetering potentiometer is mechanically linked to the indicator potentiometer. The analytical data may be transmitted as a variable low DC voltage. The normal receiver for the telemetered data is a standard DC recording potentiometer. Process control is accomplished by using the controlled air signal from the recording potentiometer. The possibility of direct pneumatic telemetering or control by linking a flapper valve to the indicator shaft is present.

The "sensitivity shunt" in Fig. 1 is a low resistance in parallel with the indicator potentiometer and the manual standard adjustment potentiometer. This shunt can be varied to control the overall sensitivity of the electrical system. Small changes in the electrical sensitivity are accomplished by the dual "span" potentiometer.

Operation of the automatic standardization circuit may be seen in Fig. 1. At a preset time the "master timer" activates a "slave timer" which governs the programming of the standardization events. A pure hydrocarbon from an external cylinder replaces the sample in the sample cell. Cam-driven switch No. 2 changes the amplifier input from the indicator potentiometer to a standard potential representing a balanced bridge relative to point *B* on the standardization potentiometer. Cam-driven switches No. 1 and 3 remove the amplifier output from the indicator servo-motor and connect it to the standardization servo-motor.

Any "error signal" entering the amplifier is balanced to a null by adjusting the standardization potentiometer at point *B*. This action compensates the analyzer for any zero "drift" resulting from source aging, ambient temperature variations, dirty cell windows, etc. The servo-system is of the null balance type, hence the amplifier gain may vary without affecting the analytical data.

In addition to normal automatic zero standardization, Phillips has developed two other standardization schemes to improve data presentation and instrument accuracy. Not illustrated in the simplified Fig. 1, but available when required, are span standardization and a variable zero standardization system.

The variable zero standardization is an automatic zero depression device that allows a full scale analytical span —say 0% to 10%—to be shifted at will to any portion of the scale, such as 60% to 70%, or 80% to 90%. This system allows the full use of the analyzers' sensitivity in multistream applications when there is a wide variance in the basic concentrations.

Span standardization automatically calibrates the fullscale range of the analyzer at any preset interval. This circuit greatly improves the absolute accuracy of the analyzers' data.

The Phillips instrument is made to handle five streams in a cyclic fashion. The normal cycle period is 12 minutes; i.e., five analyses per stream per hour. The analytical time for a sample is adjustable, however. Stream marking may be provided when it is necessary to identify each stream beyond question. When the data are placed on a circular chart, the record drawn will be similar to that shown in Fig. 2.

Switching from one stream to another, and from "unknowns" to standardization is accomplished by a series of cam-driven micro-switches from the shaft of a synchronous motor connected to the AC power supply to the instrument. This motor is similar except for size to that used to drive the familiar electric clock.

Each sample line to the analyzer carries a solenoid valve actuated by the micro-switches controlled by the master-timer, which opens the individual line to the sample manifold and closes all others. The reference standard supply line is connected to this manifold also and is similarly controlled. The solenoid valves on the sample lines may be either "open-

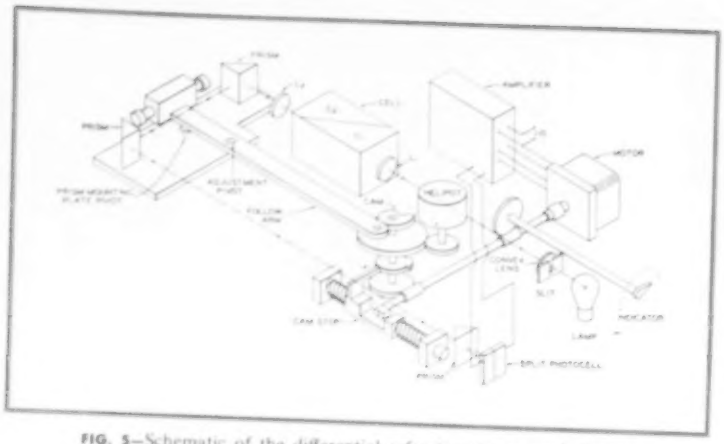


FIG. 5—Schematic of the differential refractometer as an indicator or a recorder-controller

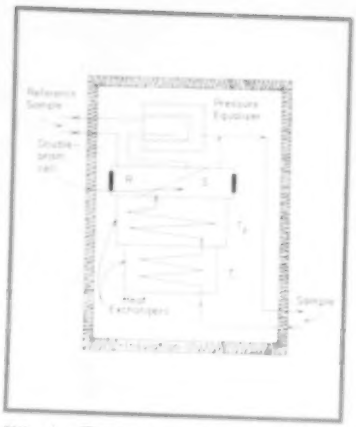


FIG. 6 — Temperature-pressure equalizer for refractometer

close" or the two-way variety, depending on whether or not it is desirable in a particular installation to continually purge the lines to maintain a fresh sample or for other reasons. All valves are connected to "fail safe."

The sequence of operation during the cycle is usually standardization followed by the five sample streams, whence the cycle is repeated.

The instrument is divided physically into two separate portions. In the upper, insulated compartment, as indicated by the photographs, is the analytical section of the instrument, including the associated amplifier and servo-motors below a horizontal baseplate. The amplifier, the most likely spot in the instrument to require periodic servicing, is of the "unitized" type and can be unplugged readily for quick substitution of a tested unit.

The automatic timing mechanism and sample line manifolding are contained in a lower compartment, likewise explosion-proof. With this arrangement, any change in sample connections or timing adjustments may be made without disturbing the analytical section of the instrument. The power supply for this part of the instrument is entirely separate from the analytical end.

Both compartments are enclosed by explosion-proof steel bells riding on support rods and mating with an aluminum face-plate.

A typical application of the infrared instrument is the control of a butane splitter at Phillips' natural gasoline plant in Borger, Texas, as shown in Fig. 3. It will be noted this column is conventionally equipped with a reboiler liquid level controller on the

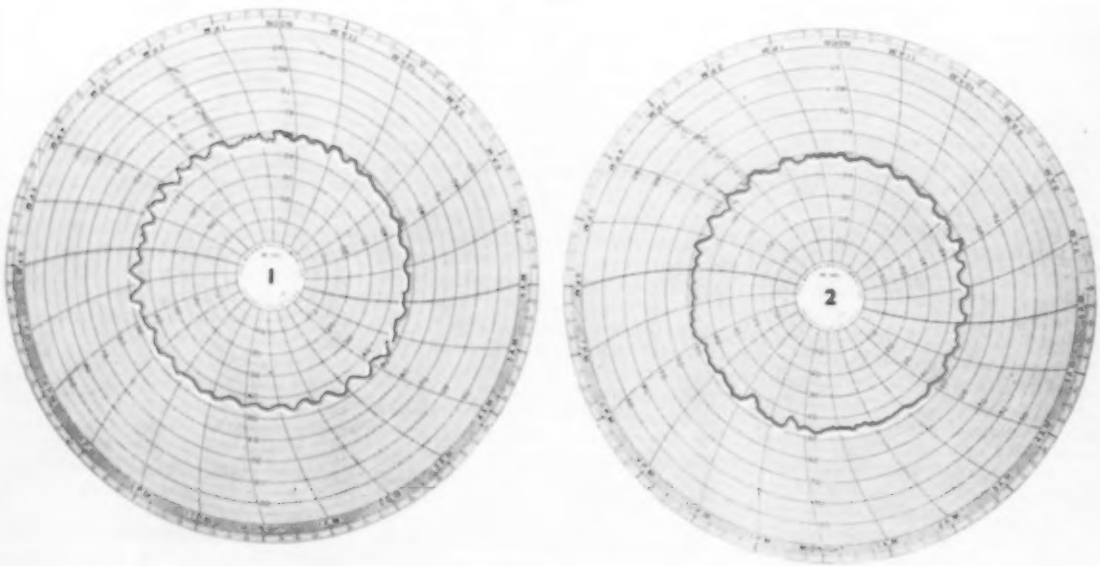


FIG. 7—Charts 1 and 2 show refractometer maintaining cyclohexane content within ±0.585% on a hexane splitter. In Chart 3, the unit monitors conventional control devices with manual control of set point showing lack of precise control. In Chart 4, operation steadies as column returns to refractometer control

bottoms (n-butane) stream; an overhead product liquid level controller regulating reboiler steam and a flow controller on the reflux stream to the column. The infrared analyzer is controlling the composition of the bottoms (n-butane) product by resetting the set point of the flow controller on the overhead product stream. Changes in the overhead product rate vary the steam to the reboiler and maintain a constant-composition kettle product.

The analyzer is located as closely as possible to the sample point, and transmits its analysis via electrical telemetering to the control room where it is recorded by a single-trace pen. A direct-reading indication also is provided on the instrument for field reference. As the photograph of the instrument's control panel indicates, the manual controls for various operating adjustments are readily accessible from outside the explosion-proof instrument housing. A rate-of-flow indicator in the line to the sample cell assures the operator that the desired flow rate is maintained.

Sample point selection on the column is based on the same principles as those applying for a temperature controller. That is, a point is selected which shows the greatest normal variation in concentration of the desired material. For the infrared analyzer, a composition profile is made of the column relating the concentration of, say isobutane in n-butane, existing on each tray. The plotted results will resemble Fig. 4. The sampling point is selected on the "plateau" where the change in concentration of n-butane is greatest.

Table 1 compares the analyses of two streams made by one of these instruments in an alkylation unit of a non-Phillips refinery with an infrared analysis made in the laboratory for check purposes. "Spot 111" is the recycle isobutane to alkylation, while "Spot 118" is n-butane to storage. The data speak for themselves.

Differential Refractometer

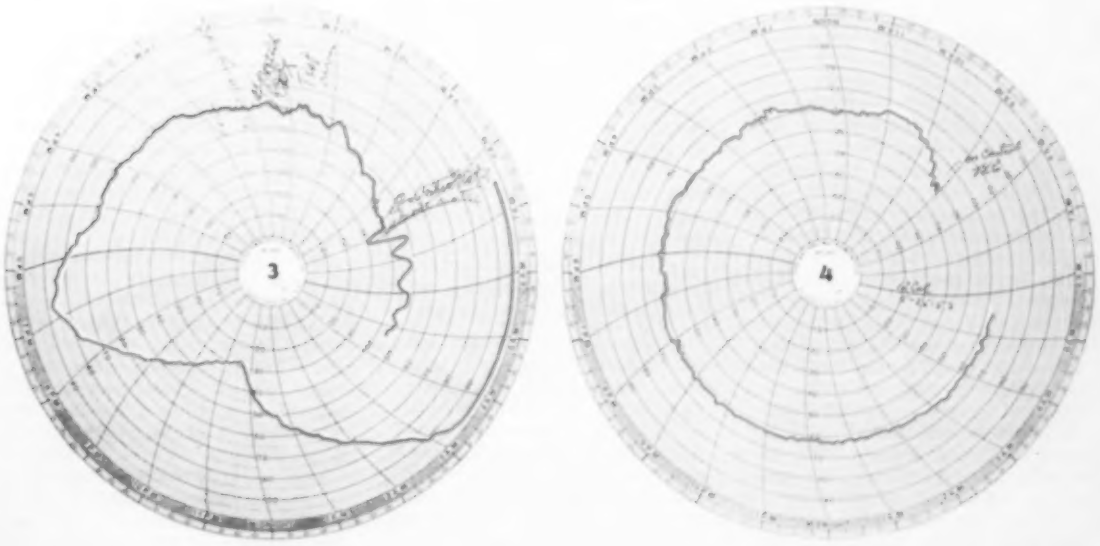
The Phillips differential refractometer is a relatively simple instrument like the companion infrared analyzer. It is an automatic comparator. Use is made of the bending of light as it passes through the sample as a measure of refractive index.

An incandescent light source (not monochromatic) is used. The light-beam is passed through the reference and sample cells (C_1 and C_2) placed diagonally end-to-end and from there the source image is diverted, as shown schematically in Fig. 5, by the two prisms onto two barrier-layer photocells. The difference between the respective outputs of the two photocells, as when one receives more light than the other, is amplified to drive a servo-motor in a direction which will move the prism table enough to restore a null-balance in the sensing circuit; that is, to divide the illumination equally between the photocells.

The cells are a two-piece unit of stainless steel, separated into two sections, C_1 and C_2, by a window inclined to the optical axis at an angle of 26°. This window and the two vertical end windows are made from quartz, sealed in place with plastic O-rings. The effective aperture of the cell is 0.5 in. Fluid for the reference cell may be either "locked in" or flowing.

The source is placed at the focus of a converging lens, L_1, collimating the light passing through the cells. At the cell outlet window another converging lens, L_2, is placed; in this case having a focal length equal to the distance from the lens to the barrier-layer photocells. An illuminated slit of width slightly more than the gap between the two photocells is used when the differential index of refraction span is less than 0.01 units. This prevents excessive "drift" caused by changes in position of the source filament, and also compensates for variation in source intensity, unequal photocell sensitivities and changes in photocell sensitivity.

No displacement of the light source from the optical axis will occur when the refractive index of the sample is the same as that of the reference standard. When the index is different, the light beam will be displaced (bent) from the "equicomposition path" by an amount proportional to the differential between the respective refractive indices of sample and standard, whence more illumination will fall on one of the photocells than on the



other. This unbalances their respective outputs.

The prism table is moved by a cam-and-lever arrangement, the cam being driven by the servo-motor. The direction of unbalance is indicated by the polarity of the output and magnitude of unbalance by the potential impressed on the control grid of the tube driving the first stage of amplification. The indicator on the face of the instrument is driven from the servo-motor shaft through a worm gear and registers on an arbitrary scale numbered from 0 to 100.

Remote indication, or recording, of differential refractive index is obtained by gearing a voltage-divider ("Helipot") to the cam-shaft drive controlling the prism table and indicator. A constant voltage is applied to this divider so that the potential between one end and the sliding contact is a measure of the rotational position of the cam. This output voltage is transmitted to the bridge circuit of a conventional potentiometer-type recorder or recorder-controller.

The reference standard is normally a sample of the desired product which meets specification requirements in all respects, whether or not refractive index actually might be specified. This gets away from the several potential disadvantages of the glass standard and also eliminates the use of a monochromator source or dispersion devices.

The color of the light transmitted by the sample does not affect the accuracy of instrument with light colored samples. This is another logical reason for using a specification-acceptable sample as the reference standard, since its dispersion will be most nearly identical with the test sample. The color of the light-beam becomes important only when impurities which may be present in the test sample differ markedly in both color and dispersive power from the reference standard. Beam dispersion then may occur when it is greatly bent away from the "equi-composition path," and this effect could be exaggerated if the impurities act as a light filter.

The production instrument differs somewhat from that shown in the schematic in Fig. 5, due principally to the necessity of assuring that sample and standard are at the same temperature and pressure. An ingenious arrangement is used to equalize these.

It works so well that precise pressure control and thermostatting are not required in the field. Actual tests show a stability of measurement of ±0.00002 refractive index was obtained with a flowing sample of isopentane at 50 psig. when the refractometer was subjected to sudden ambient temperature changes of up to 30°F.

The equalizing system consists of two heat exchangers of relatively large thermal capacity, a bellows-type pressure equalizer and the refraction cells arranged as in Fig. 6. Heat exchanger T_1 is a fluid-filled tank, maintained at approximately the same temperature as the standard because it is within the same insulated enclosure and which coud be externally heated if necessary. Heat exchanger T_2 is another tank in physical (and termal) contact with one wall of both refraction cells, C_1 and C_2.

The sample entering the insulated chamber is brought to approximate temperature in exchanger T_1 by passing through the tube-side, and to the same temperature as the reference standard in exchanger T_2 before entering cell S. The sample leaving cell C_2 is pressure-equalized by coming in contact with one side of the bellows while the reference standard in cell C_1 in contact with the other side, is compressed or expanded as circumstances may dictate. In cases where the sample pressure might be far greater than practical for the instrument (the cells are hydrostatically tested to 500 psi. and have been operated at up to 140 psig.) a simple pressure regulator could be used.

The instrument is divided physically into two vertical sections, as shown in the accompanying photographs. The chamber on the right contains the optical system and Helipot telemeter transmitter, as well as the two heat exchangers (T_2 of Fig. 5 is underneath the horizontal baseplate). The walls of the measuring chamber and the covering around the source are insulated with an inch of cork; electrical and sample connections are brought out through the faceplate.

The left chamber, uninsulated and partly hidden in the photograph, contains a Brown "Electronik" continuous-balance unit (servo-amplifier and motor), telemeter power supply and the light source power transformer. Both chambers are housed in a 60-lb. explosion-proof bell attached to an aluminum faceplate which meets National Electrical Code, Class 1 Group D, requirements.

Several instruments have been in use in Phillips' refineries for some time. One installation is a routine operational control for a distillation column separating cyclohexane from n-hexane. The difference in respective indices of refraction is 0.05137 (cyclohexane, n^{20}1.42623, n-hexane, 1.37486; b.p. difference 26.0°F).

Charts 1 and 2 (see Fig. 7) are successive day's operations for this distillation. The chart span shown represents a change in n-hexane purity of 19.5% and each scale division 0.0001 unit. For the chart range, this represents a change of 0.01 in refractive index. On both charts the amplitude of the variation in index is approximately 6 scale divisions, or ±0.0003 refractive index about the set-point. Therefore, the variation shown represents a change in n-hexane content of the cyclohexane of ±0.585% (±3 × 19.5% ÷ 100) under the control of this instrument. (The instrument was controlling in cascade by resetting a flow-controller on the overhead hexane stream to storage.)

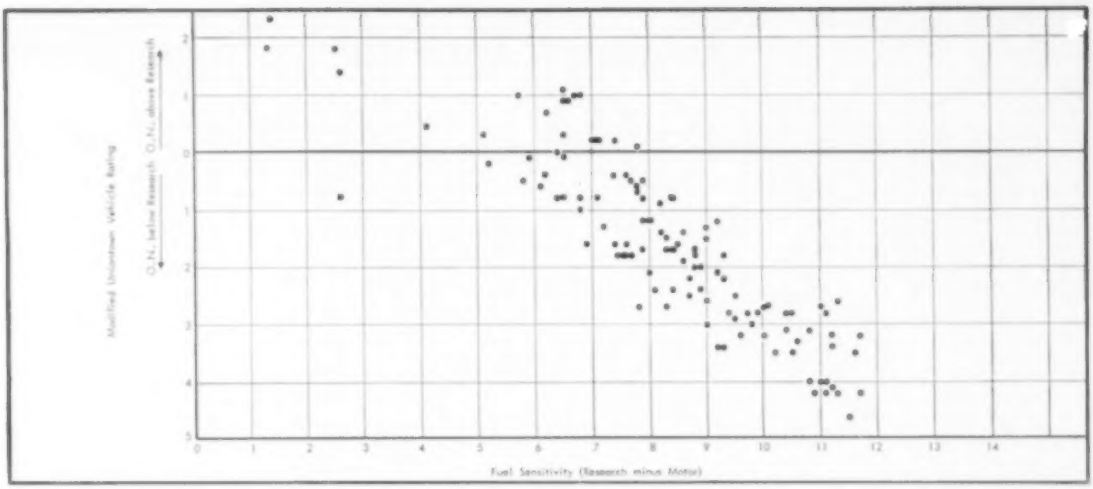
Charts 3 and 4, on the same setting as Charts 1 and 2, show the results of an experiment comparing the ability to control the column by means of the automatic differential refractometer with the manual effort of an operator relying on the usual control instrumentation. During the latter test, the refractometer was allowed to indicate only and was masked so the operator could not see the trace.

Chart 3 shows the commencement of the test, when the column control point was adjusted at 8 a.m. and allowed to line-out until noon. At 12:25 p.m. the refractometer was taken off control but allowed to record. The column then was under temperature control, based on indication at the 12th tray. A drift trend immediately set in and the hexane concentration went beyond the chart range by 3:30 a.m. the following day.

Chart 4 shows the conclusion of the test series (charts which are omitted for the intervening period show a similar inability of the temperature controller to hold composition of the column overhead stream satisfactorily without the aid of the reset adjustment supplied by the differential refractometer). It will be observed that the column lined out within 90 minutes when the refractometer was put back on control and a reasonable constancy in overhead stream composition was maintained through the balance of the period covered by the chart.

Consolidated Engineering Will Make Phillips' Instruments

Phillips Petroleum Co. and Consolidated Engrg. Corp. have just concluded an agreement under terms of which Consolidated will manufacture and market continuous plant analysis and control instruments developed by Phillips. This will include the two devices described in this article as well as others now in development stages.



SIGNIFICANT TREND shown in this plot of fuel sensitivities of 63 premium gasolines in a late model high compression car indicates that the higher the sensitivity the greater the depreciation in the road rating

Fuel Sensitivity . . .

The Key to Road Performance?

By V. B. GUTHRIE
Associate Editor

THE extent to which fuel sensitivity can be used as an indicator of actual vehicle antiknock behavior on the road is the subject of a current research program by the Ethyl Corp.

Sensitivity is not a new word to the industry. It is the numerical difference between Research octane number and Motor octane, both obtained through the standard laboratory methods of making octane ratings on gasolines. Research ratings correlate best with low speed engine performance, Motor ratings with engine performance at high speeds.

The purpose of the research, which also includes other conditions affecting engine knocking, is to find a ready means to predict the road performance of fuels from the available engine laboratory tests. The actual knock testing of fuels in automobiles on the road is limited to the few test vehicles the oil company or other agency can operate—far from sufficient to evaluate fuels for all customers' cars.

With an indicative correlation from laboratory tests, the individual refiner —knowing the crude petroleum he has to work with—could apply his particular processing facilities to tailor his fuels to better fit the actual antiknock requirements of his customers' cars.

Because of the greater cost of manufacturing the higher antiknock quality fuels the automobiles of coming years will demand, it is important to the refiner that each increase in laboratory octane number result in a similar gain in road antiknock value.

Ethyl Corp., starting in 1946, has conducted four investigations of the antiknock characteristics of U. S. premium gasolines, its study of 1954 fuels emphasizing fuel sensitivity analyses.[1] High sensitivity is regarded as generally indicative of the decreasing ability of a fuel to resist knocking as engine operating conditions become more severe.

The converse is also true. High sensitivity is indicative of the increasing ability of a fuel to resist knocking as engine operating conditions become milder.

This is another way of saying that high sensitivity, which comes naturally as a result of today's refining processes, tends to give best performance in those engines which rate fuels at or above the research method. As a matter of fact, refiners would have trouble decreasing sensitivity in the face of the present wide application of catalytic cracking and reforming processes.

The current Ethyl report on road behavior of commercial premium fuels in 1954, while recognizing many exceptions, suggests that the general trend is toward an increase in depreciation (Research rating minus average road rating) with higher sensitivity. In other words: as octane numbers increase, Research octane alone is less of an indicator of road antiknock requirements. Thus, engine designers might keep this trend in mind and put even more emphasis on the design of engines wherein road performance corresponds closely with research octane rating, so as to make the best use of today's fuels.

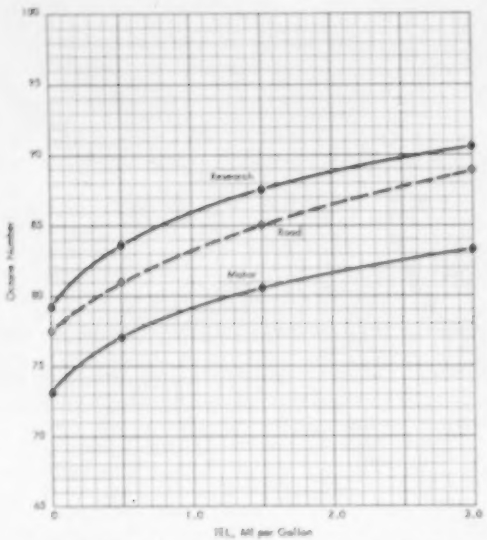
Road ratings were determined in the Ethyl Corp.'s work by the Modified Uniontown technique, widely accepted as the test most closely simulating road performance. The readings were taken at predetermined maximum-knock operating conditions. To this extent the rating procedure deviates from that prescribed in the CRC (Cooperative Research Council) Method F-28, which specifies wide open throttle of the test vehicle.

The road evaluations were conducted on the chassis dynamometer in an all-weather room, which was maintained at 65° F. and a relative humidity of 40%. Duplicate ratings were obtained in each blend tested by separate crews working on a two-shift schedule, to eliminate the factor of human error.

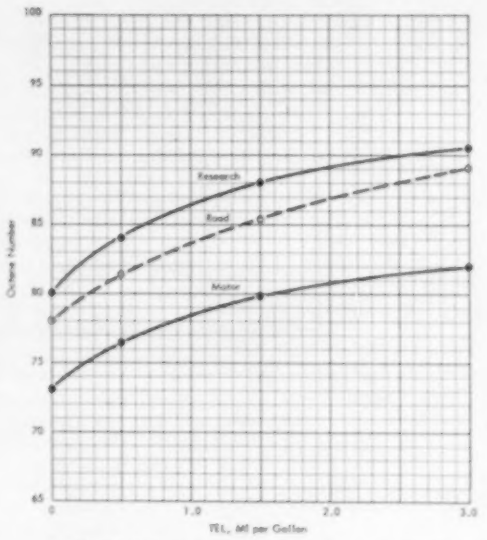
The trend in antiknock behavior of commercial premium fuels over eight years, as determined in the Ethyl Corp. program, is shown in Table 1 and a series of four charts.

The charts compare Research and Motor octane numbers and road rat-

Antiknock Behavior of Premium Fuels



1946—12 fuels tested, road rating average for 8 cars



1949—20 fuels tested, road rating average for 8 cars

ings (as obtained by the Modified Uniontown procedure) for the fuels tested in each of the four surveys, at TEL concentrations of both 1.0 and 3.0 ml./gal. Fuel sensitivity with 1.0 ml. TEL has increased from 6.7 points in 1946 to 8.2 points in the 1954 investigation. The average sensitivity for fuels with 3.0 TEL increased from 7.3 in 1946 to 8.4 numbers in 1954.

The average depreciation (Research minus road rating) in the 1.0 ml. TEL fuels was 2.3 points in the 1946 survey; 2.1 in 1954. In the fuels with three ml. TEL, depreciation was 1.8 in 1946, 2.3 in 1954.

The average laboratory and road antiknock data obtained in the 1954 study of 63 base stock premium gasolines comprising 126 road test blends at nominal TEL concentrations of 1.0 and 3.0 ml./gal. are tabulated below:

	1.0 TEL	3.0 TEL
Avg. Research Octane	90.9	94.7
Avg. Motor Octane	82.7	86.3
Modified Uniontown, 8-Car Avg.	88.8	92.4
Depreciation	2.1	2.3

For individual gasolines with 3 ml. TEL which were tested in the 1954 survey, sensitivities and depreciation varied widely from the averages of the 63 base gasoline stock gasolines.

The range in sensitivities with the individual fuels was from 1.3 to 12.4 points, the depreciation range was from —0.2 (an appreciation) to 4.1 points. (See Table 2.)

The fuel with the highest sensitivity had the highest all-car depreciation. The fuel with the lowest sensitivity had the lowest all-car depreciation. Actually it was an appreciation. Lowest sensitivity was 1.3 in an experimental gasoline submitted in the survey. This gasoline had a 90% distillation point of below 280° F.

To illustrate the exceptions, Fuels 181 and 189 in Table 2 were quite different in sensitivity. However, they were very similar in average road depreciation. Sensitivities of Fuels 181 and 189 were 11.1 and 6.9 respectively, compared with their depreciations of 2.5 and 2.3 respectively. Depreciation of 2.3 points was the 63-fuel, all-car depreciation average.

The influence of fuel sensitivity on the Modified Uniontown antiknock performance of the test blends was correlated in the eight test cars. The plot of this data for one of the 1954 cars with a compression ratio of 8.25 to 1 is shown in an accompanying chart. The Uniontown rating is given in terms of octane numbers above Research and below Research.

The pattern shown in this chart of increasing depreciation with higher sensitivity was similar to that of five others of the eight test cars, and is believed to indicate the decreasing ability of a fuel to resist severe engine knocking conditions. The relationship between sensitivity and depreciation for the other two cars in this program showed no definite pattern.

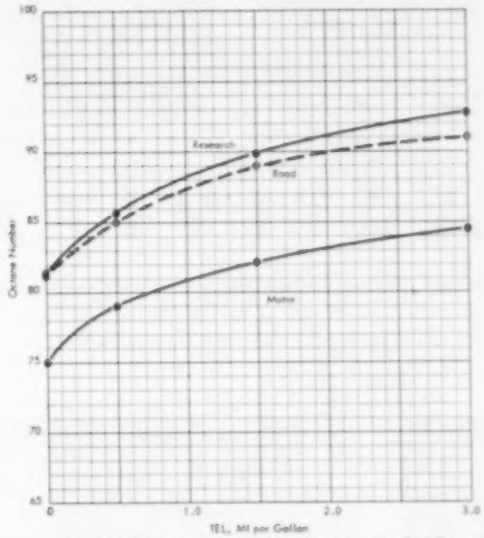
The 1954 investigation was conducted on 63 premium grade fuels submitted by 39 U. S. refiners. The 59 participating refineries of the 39 companies supply approximately 70% of the nation's motor gasoline. The premium gasolines evaluated in the program should represent a cross section of fuels currently available.

In the test procedure, a two-drum quantity of each of the 63 base stock

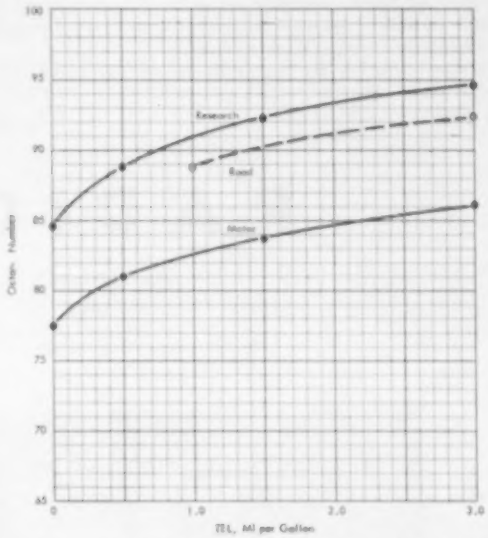
Table 1—Antiknock Performance of Premium Fuels Tested in the Four Programs of the Ethyl Corp.

Year	Number of Fuels Tested	Avg. Oct. No. at 1.0 ml./gal. TEL			Avg. Oct. No. at 3.0 ml./gal. TEL		
		Res.	Motor	Road	Res.	Motor	Road
1946	12	86.0	79.3	83.7	90.8	83.5	89.0
1949	20	86.5	78.5	84.0	90.8	82.2	89.0
1951	31	88.3	81.1	87.6	92.8	84.7	91.0
1954	63	90.9	82.7	88.8	94.7	86.3	92.4

over a Period of Eight Years



1951—31 fuels tested, road rating average for 9 cars



1954—63 fuels tested, road rating average for 8 cars

gasolines submitted by the refiners was composited and put through routine laboratory inspections. Road test blends were prepared from each base stock at nominal TEL concentrations of 1.0 and 3.0 ml./gal. The laboratory Research and Motor octane levels of the test blends were obtained from the TEL response curves obtained on the base stock gasolines.

The eight test vehicles used in the program to evaluate the road antiknock behavior of the 126 test blends were late model standard cars of relatively high octane number requirements, which normally require premium fuels.

Table 3 gives the compression ratio of the eight test cars and should also show the average Modified Uniontown ratings obtained in each vehicle with both 1.0 and 3.0 ml. TEL additions, also the commercial fuel octane number requirement computed by using the average depreciation obtained on the test blends.

The antiknock quality of the more volatile fractions of the test fuels came in for some study in the current Ethyl Corp. investigation. Preliminary analyses were also made with respect to the effect of ignition timing on the road depreciation of the test fuels. Results so far have not led to significant conclusions in these studies.

(1) "Road Behavior of Commercial Premium Fuels, 1954," Ethyl Corp. Research Laboratories, Detroit.

Table 2—Laboratory and Road Octane Ratings, Sensitivities and Depreciation, on Selected Fuels with Approx. 3 ml. TEL, in Ethyl Corp. Survey

Fuel Number	Research Oct. No.	Motor Oct. No.	Sensitivity	Avg. Rd. Rating	Deprec.
151	92.9	86.7	6.6	92.0	0.9
156	96.9	87.4	9.5	94.5	2.4
173	93.2	84.9	8.3	91.0	2.2
178	93.2	84.6	8.6	91.3	1.9
181	96.0	84.9	11.1	93.5	2.5
185	95.2	85.2	10.0	92.7	2.5
189	92.4	85.5	6.9	90.1	2.3
194	95.6	89.1	6.5	93.9	1.7
207	94.8	88.4	6.4	93.2	1.6
210	94.4	86.3	8.1	91.5	2.9
212	95.4	92.8	2.6	94.1	1.3
213	99.6	89.1	10.5	97.0	2.6
214	99.2	97.9	1.3	99.4	—0.2
218	95.2	86.6	8.6	93.1	2.1
219	96.6	84.2	12.4	92.5	4.1
221	97.6	88.4	9.2	95.1	2.5
225	94.7	86.4	8.3	92.8	1.9

Table 3—Compression Ratios and Related Antiknock Data on Eight Cars of High Octane Number Requirements

Car	Comp. Ratio	Modified Uniontown Rating 1.0 ml TEL	3.0 ml TEL	Commercial Oct. Requir.
1953 Make A	8.5:1	88.9	92.0	87.5
1954 Make A	8.5:1	88.4	91.3	89.5
1953 Make B	8.25:1	88.5	91.5	92.5
1954 Make B	8.25:1	89.4	92.8	90.5
1954 Make C	7.5:1	88.8	91.9	84.5
1953 Make D	8.0:1	86.6	90.7	89
1954 Make D	8.25:1	89.7	94.8	95
1954 Make E	8.0:1	89.9	94.5	95

Why You'll Want to Read This Story: *This article will not help you make better products, run a more efficient plant, or do your own individual job better. It has nothing to do with petroleum processing, per se.*

However, it is educational. Written by a Standard Oil Development Co. engineer who has been working with radioactivity for some time, it represents the kind of information he and his company felt necessary to get down on paper as a means of in-plant education. SOD has been doing some pioneering work in the application of atomic energy to petroleum (January, 1955, pp. 43-46), as have several other oil firms.

Because of the growing interest in this field the Editors of PETROLEUM PROCESSING *believe you will find this concise discussion of radioactivity—its principles and application—well worth your reading time.*

AUTHOR McArthur

RADIOACTIVITY

—*Its principles and applications*

OUT-OF-BOUNDS EXCEPT for authorized personnel, a safety precaution at Standard Oil Development Co.

CAREFUL HANDLING is a must in opening containers of radioactive materials for use in the laboratory

MEASURING RADIOACTIVITY in an oil sample (Mr. McArthur, at right). John Rabetz, at left, checks a "multi-scaler."

KEEP A SAFE DISTANCE when carrying radioactive samples of material with extra-long tongs

By DONALD S. McARTHUR
Standard Oil Development Co.

SINCE 1940 the use of radioisotopes in industrial work has become popular. Not everyone has the time to keep up with this rapidly changing and new field. It is helpful to have a basic understanding of radioactivity in thinking about possible applications in the petroleum field. All the evidence indicates that radiation will have a profound impact on the oil industry.

What Is an Atom?

For the purposes of this discussion we can think of an atom as made up of a dense nucleus with several light electrons flying in orbits about the nucleus. The electrons are small particles carrying a negative electrical charge. There are usually just enough negative electrons flying around the nucleus to balance the positive charges on the protons in the nucleus (one electron for each proton).

Therefore, we will ignore the electrons and talk about the protons. The dense nucleus is made up of two types of heavy particles, protons and neutrons. The protons and neutrons are of about the same weight. They differ in that the protons carry a positive electrical charge, whereas the neutrons are electrically neutral.

The chemical properties of the atom depend upon how many protons are in the nucleus. For example, all atoms which contain 16 protons in the nucleus are sulfur atoms. All atoms which contain 15 protons are phosphorus atoms, and all those containing 17 are chlorine, and so on.

Usually there are about as many neutrons as protons in the nucleus. For example, the commonest type of sulfur atom contains 16 neutrons (with the 16 protons), and the commonest type of chlorine atom contains 18 neutrons (with the 17 protons). However, the number of neutrons in the nucleus can change without a change in the chemical properties of the atom. For example, about one-quarter of the chlorine atoms in nature actually contain 20 neutrons. These heavier chlorine atoms have exactly the same chemical properties as the lighter chlorine atoms. Both atoms are stable.

There is a type of chlorine atom, however, which contains only 19 neutrons. This chlorine is identical chemically with the stable chlorine but differs in that it tends to break down. A fourth type of chlorine contains 21 neutrons. This type breaks down very quickly. Other unstable types of chlorine atoms exist which contain 16, 17 and 22 neutrons in the nucleus.

The Different Kinds of Atoms Are Called Isotopes

These different kinds of chlorine atoms are called isotopes of chlorine. The isotopes are named by adding the number of protons to the number of neutrons. For example, the chlorine isotope which contains 17 protons (all chlorine atoms contain 17 protons) and 18 neutrons is called Chlorine 35 (Cl 35). About ¾ of the chlorine found in nature is Cl 35. All told, there are at least 7 different chlorine isotopes, all identical in chemical properties but different in weight and stability. There are 7 isotopes of sulfur, 14 isotopes of mercury, 20 isotopes of iodine, and so on.

Among the hundred odd elements making up the universe, there are more than 1200 different isotopes. About 1/3 of these are stable isotopes found in nature, and about 2/3 are unstable. Most of the 800 unstable isotopes are man-made. Only about 50 of them are found in nature. Radium, for example, has 4 unstable isotopes which occur in nature.

The Unstable Isotopes Are Radioactive

Unstable isotopes tend to stabilize themselves by some sort of internal rearrangement. This rearrangement usually results in the atom shooting off particles of radiant energy.

It is this "shooting off" of particles and energy which makes the unstable istotopes radioactive. The exact moment at which any individual atom will stabilize itself (disintegrate or decay) cannot be predicted.

However, when a large number of unstable atoms, such as Chlorine 38, are together, it is possible to predict on a statistical basis exactly how long it will take for half of them to decay. It has been found experimentally, for example, that half of the Cl 38 atoms in any quantity of chlorine-containing material will decay in 37.5 minutes. Half of the remaining Cl 38 atoms will disintegrate in the next 37.5 minutes, and so on. The *half-life* of Chlorine 38 is said to be 37.5 minutes. The *half-life* of Chlorine 36 is known to be about 40,000 years. The half lives of the 800 odd radioactive isotopes known range from microseconds to millions of years.

When unstable isotopes disintegrate, many things can happen. The atom may change to a different chemical by losing protons or making new protons out of neutrons. For example, a sulfur atom may become a chlorine atom, and a cobalt atom can change to nickel. During the change the atom may shoot out a heavy particle containing two protons and two neutrons.

This type of particle is called an *alpha particle*. Or the atom may shoot out an electron. Electrons shooting out from the atom are called *beta radiation*. Sometimes the atom merely shoots out a flash of light. This light is called *gamma radiation*.

Various other things can happen. For example, the atom might shoot out first an electron then a flash of light, or it might shoot off a neutron or some other type of atomic particle. Atoms of a particular isotope will always disintegrate in exactly the same way; for example, S 35 always produces beta radiation.

Radioactive Isotopes Are Useful

The radiations coming from the unstable isotopes as they rearrange can be detected by instruments. This makes the unstable isotope useful in industrial and research work. It is actually possible to measure the amount of radio-active material in a sample in which only 100 atoms are disintegrating per minute.

In other words, very small amounts of material can be detected. It is possible to detect less than a millionth of 1 billionth of a miligram of pure isotope. This tremendous sensitivity in detection puts the use of radioactivity in a class by itself as an analytical technique.

The three main kinds of radiation (alpha, beta, and gamma) coming from atomic rearrangements vary in properties. Alpha radiation is not penetrating. For example, most alpha radiation will not penetrate a sheet of paper. It is not as useful as beta and gamma radiation in most applications for this reason. Beta radiation is more penetrating, and as a result is useful in tracer work. Gamma radiation is very penetrating (gamma rays are very similar to X-rays) and can be used to penetrate through heavy thicknesses of metal.

The uses of radioactive isotopes can be divided into three fields:

1—Where the isotope is used because of its ready detectability.

2—Where nonradioactive isotopes can be made radioactive and then detected.

3—Where the radiations from the isotopes are useful in promoting some action such as killing germs or promoting a chemical reaction.

Tracer Work—The first field mentioned includes all tracer work. For example, radioactive isotopes can be

put into products flowing along pipe lines at the interface between two types of product. This interface can then be detected by suitable instruments as it passes through the pipe. Radioactive iron can be used in wear studies. As iron wears off a piston ring, it goes into the lubricating oil and can be readily detected using a Geiger counter. The amount of wear occurring is proportional to the amount of radioactivity in the oil. Carbon 14, Sulfur 35, Phosphorus 32, and many other elements can be used in chemical reactions to study the mechanism of the reaction.

Activation Analysis—The second field includes all types of activation analysis. Stable elements can be made radioactive in an atomic pile by the absorption of more neutrons. The atomic pile can be pictured as a big container of neutrons. Materials soaked in this container tend to soak up extra neutrons. For example, Chlorine 37 (which is stable) can be put into an atomic pile where it will absorb another neutron and become Chlorine 38 (unstable). The Chlorine 38 is radioactive, so that the amount of Chlorine 38 present can then be determined by radioactive techniques. This technique can be used to analyze quantitatively for elements in complicated mixtures. It is possible, for example, to get a small neutron source (small pile) which could be used in a pipe line to provide a continuous analysis for chlorine. Such a system could be used to analyze continuously for chlorine (salt) in crude coming from a desalting unit.

Effect of Radiation on Matter—The radiation from radioactive materials has an influence on the surrounding material. This effect can be put to good use in some cases. Gamma irradiation has already been found to greatly accelerate some chlorination reactions. It is hoped that it may also be useful in promoting chemical reactions such as polymerization. Radiation is now being used in industry to kill bacteria in foods.

Instruments Are Available

The instruments used to detect radiation from radioactive isotopes are commercially available and relatively cheap. One of the common instruments is a Geiger tube. The Geiger tube has conducting walls and a conducting wire down the center of the tube. The conducting wire is insulated from the walls. A high voltage, e.g., 800-1000 volts, is placed across the wire and tube walls.

When an alpha, beta, or gamma ray enters the tube, it ionizes some of the gas between the wire and the tube. This leads to a temporary breakdown in the high voltage. The short burst of current through the tube operates a counting device. In this way the ionizing particles striking the tube are actually counted. A simple Geiger tube and counting circuit can be purchased for $500.

Many newer and more elaborate devices are now available such as scintillation counters and ion chambers for special jobs. More complicated detecting devices may cost as much as $2000.

Two Units Are Used in Discussing Radioactivity

The Curie is a measure of the number of atoms disintegrating in a sample per minute. In a sample containing one Curie of activity, 2×10^{12} atoms are disintegrating every minute. One Curie of activity may occupy a large or small volume. For instance, one Curie of radium corresponds to one gram of radium. However, one Curie of radioactive cobalt might weigh 100 grams or more. The Curie as a measure of the activity of a sample corresponds roughly to the wattage of a light bulb as a measure of the intensity of the light given off from that bulb.

The Roentgen is the unit used to measure the amount of radiation received. The radiation received is measured in terms of the amount of ionization occurring in the target. One Roentgen is the amount of radiation which will form 1.61×10^{12} ion pairs per gram of target air. The Roentgen unit as a measure of radiation received corresponds to the lumen unit used to measure the amount of light received on a target.

There is no simple relationship between Curies and Roentgens. All other factors being held constant, the number of Roentgens received will increase as the number of Curies in the radioactive source increases. However, factors such as the distance from the source to the target, the kind of radiation (alpha, beta, or gamma), the energy of the radiation, the type of material between the source and the target (e.g., air, water, lead) have an effect on the number of Roentgens received from one Curie of activity.

Radioisotopes Can Be Used Safely

The radiation from radioactive isotopes can have a detrimental effect on the body. The damage in the body resulting from radiation is due to ionization of the materials of which the body is made. It has been estimated that 400 Roentgens is the median lethal dose.

In other words, 400 Roentgens of radiation received in one dose over the whole body will kill half the people receiving it. One hundred to three hundred Roentgens received in one dose will produce serious injury. Twenty-five to one hundred Roentgens produces detectable damage such as a drop in blood count. However, this damage is not permanent, and the patient will recover.

The Atomic Energy Commission has set up safety standards limiting the amount of radiation which workers should receive. Since the danger in ordinary work lies in receiving small amounts of radiation over a long period of time rather than a large dose received over a short period, they have set an upper limit on the safe amount of radiation which may be received per week.

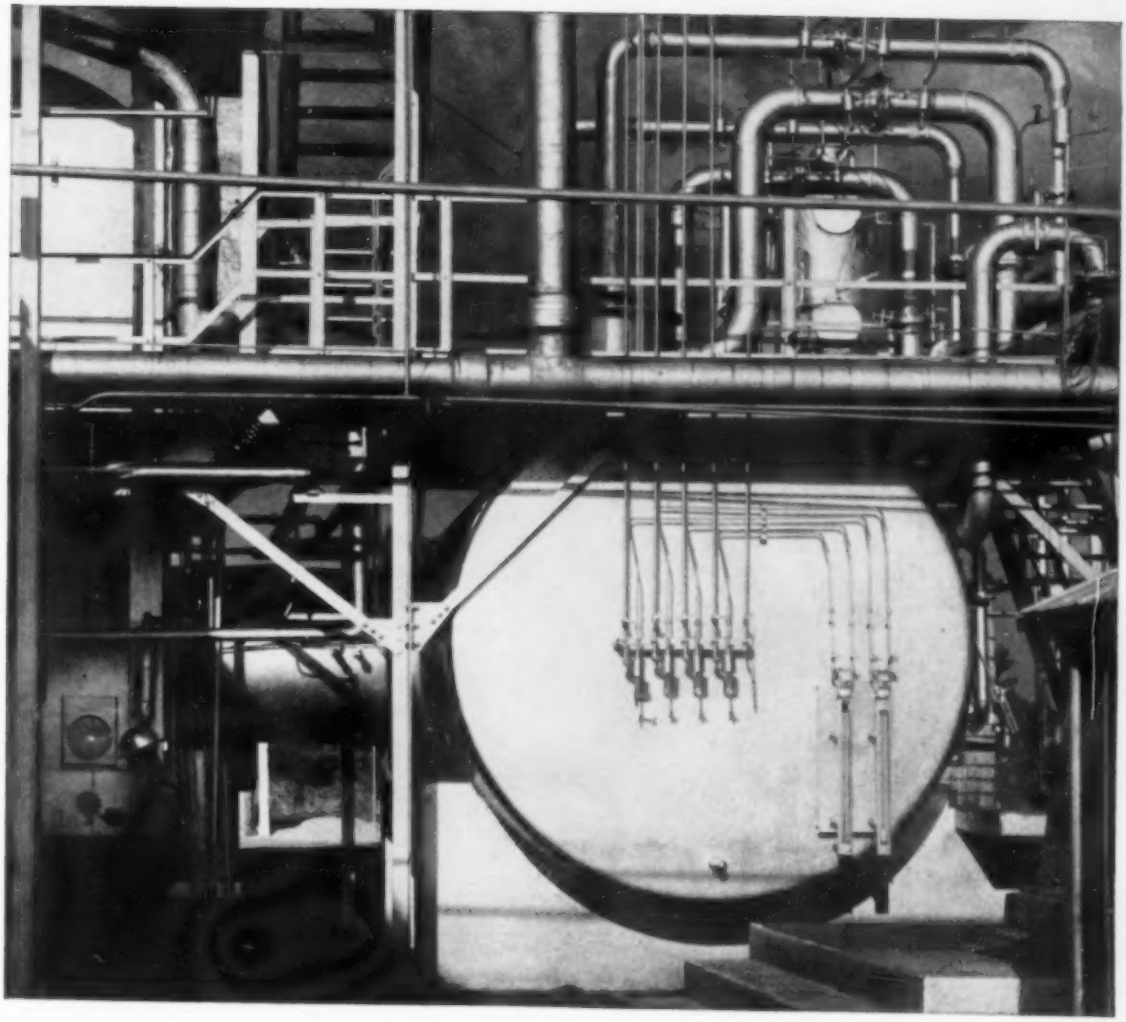
No one should receive more than 0.3 Roentgens per week on a continuing basis. This dosage of 300 milliroentgens per week has been generally accepted as the upper safe level.

Radiation work is designed to keep personnel below this level. Three hundred milliroentgens per week corresponds to 7.5 milliroentgens per hour, based on a 40 hour working week. So far, people subjected to this level of radiation over long periods of time have suffered no harm. Instruments are available such as pocket dosimeters and film badges which can be worn to guarantee that the person does not receive more than a safe level of radiation.

Meet the Author

Donald Smith McArthur is a group head in the industrial lubricants research section of the Standard Oil Development Co. laboratories in Linden, N.J., where he has been doing development work on crankcase lubes using radioisotopes in engine wear studies.

Born in Gilbert Plains, Manitoba in 1918, he received his early schooling largely in Tisdale, Sask. He received a B.E. in 1939 and an M. Sc. in 1941 in chemical engineering from the University of Saskatchewan. Mr. McArthur then spent five years as a research engineer with the Aeronautical Research Committee of the Canadian National Research Council in Ottawa. During this period he did research work on hydraulic fluids with the Royal Canadian Air Force. In 1947 he received a Ph D. in chemical engineering from the University of Toronto and then joined SOD.



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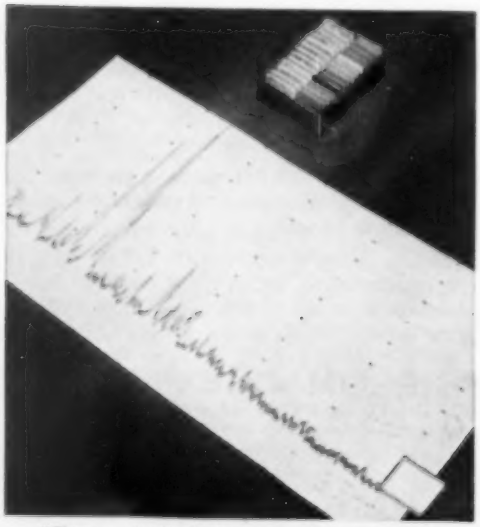
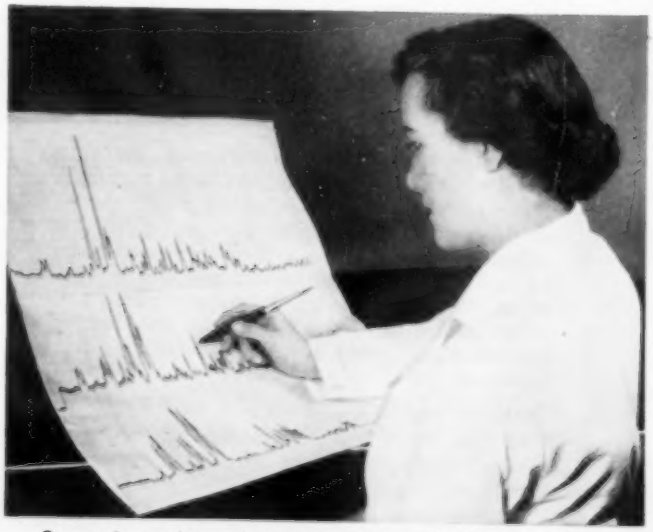
Positioning deposit sample in path of X-ray beam. Crystals of the deposit will diffract the beam, and a characteristic pattern is recorded on the chart at left.



"Fingerprint" of the deposit is recorded on this chart—showing which compounds are present in the deposit sample.



Comparison of sample "fingerprint" with Ethyl's master file of synthesized compounds permits positive identification of chemical compounds present in the sample.

Ethyl Research "fingerprints" engine deposits

Ever since the invention of the internal combustion engine, refiners and automotive engineers have known that under certain conditions engine deposits can create problems.

But to this day, no one is certain which of the many chemical compounds present in the deposits actually cause the trouble.

Ethyl research people have come up with several techniques that promise to give part of the answer.

One of these new techniques—called the "fingerprint" method—works something like this:

A special thermal plug is installed in the engine combustion chamber. Deposits are allowed to build up on the plug, which is held at a controlled temperature. After a certain time, the plug is removed, and the deposits are analyzed.

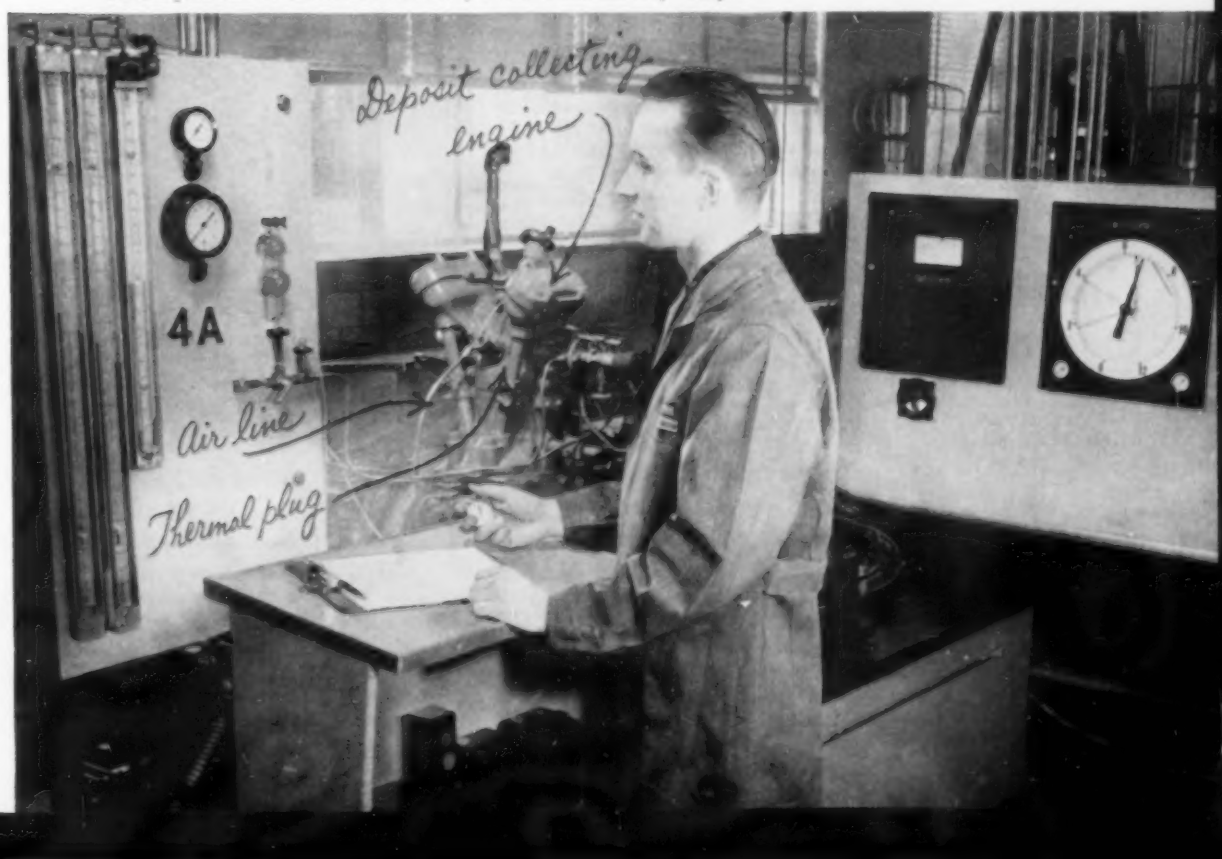
To identify the compounds present in the deposit, ordinary chemical analysis proved unsatisfactory, so Ethyl people turned to X-ray diffraction. But here again they met a problem. No master identification charts existed for these complex chemicals.

Ethyl synthesized many of the compounds they thought might be in the deposits and made X-ray diffraction "fingerprints" of them. Now, with this unique master identification file, the majority of complex inorganic chemicals present in engine deposits have been identified.

With this basic research tool, Ethyl people are studying the mechanism of deposit formation and gaining new understanding, which will lead to more effective scavenging of engine deposits in the future.

ETHYL CORPORATION
Research Laboratories
1600 West Eight Mile Road, Ferndale 20, Michigan
2600 Cajon Road, San Bernardino, California

Thermal plug in place in single-cylinder research engine. After a certain period enough deposit builds up on its temperature-controlled surface to provide a satisfactory sample.



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SIMPLICITY OF DESIGN AND CONSTRUCTION
EXCESS DRAFT FOR HIGH OVERLOAD
EXPLOSION RESISTANT
MINIMUM GROUND SPACE
SHORT LENGTH OF LIQUID TRAVEL
ZERO AIR LEAKAGE
LOW PRESSURE DROP
LOW MAINTENANCE

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2. The metal cone at the top of the combustion chamber re-radiates to the tubes, also diverts combustion gases progressively closer to the tubes to give a uniform heat intensity at the upper portion of the combustion chamber;

3. The combustion gases, at the top of the heater, are diverted towards the walls where they recirculate from the top of the heater downward, behind and between the tubes, increasing the heat input to the rear of the heating elements by convection;

4. The recirculated gases reduce the heat intensity at the bottom of the furnace so that the heat input is the same, top and bottom.

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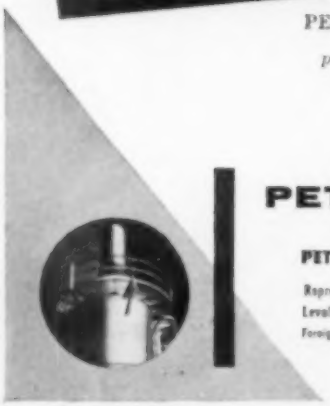

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Petroleum Processing

FEBRUARY 1955

Petrochemical Section

IN THIS SECTION

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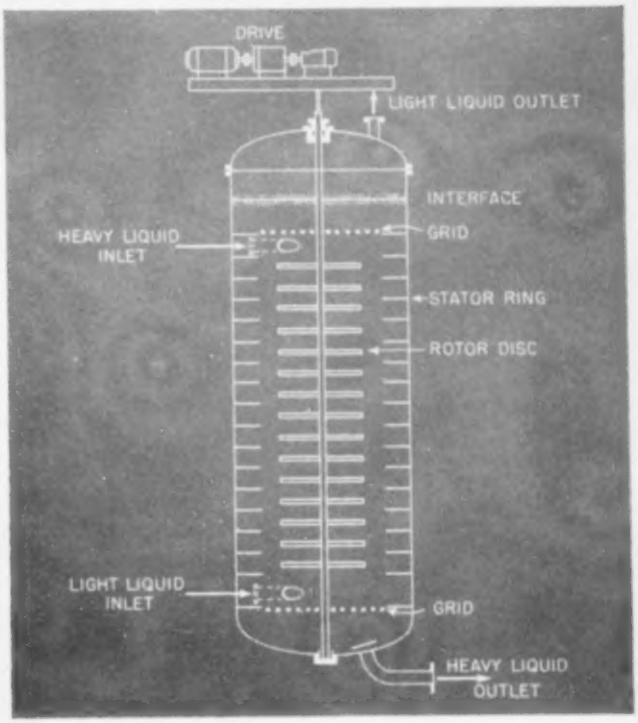

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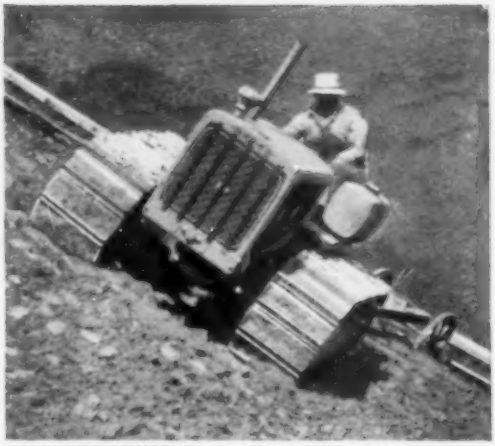

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IN CHEMICALS (*Plastics*)

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PARATAC
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PETROHOL 99
JAYSOL
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Secondary Butyl Acetate
Isopropyl Acetate
Acetone
Methyl Ethyl Ketone
Dicyclopentadiene
Ethyl Ether
Isopropyl Ether
Naphthenic Acids
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol

CHEMICAL
PETROHOL 91
PETROHOL 95
PETROHOL 99
JAYSOL
Iso-Octyl Alcohol
Decyl Alcohol
Denatured Ethyl Alcohol
Tridecyl Alcohol
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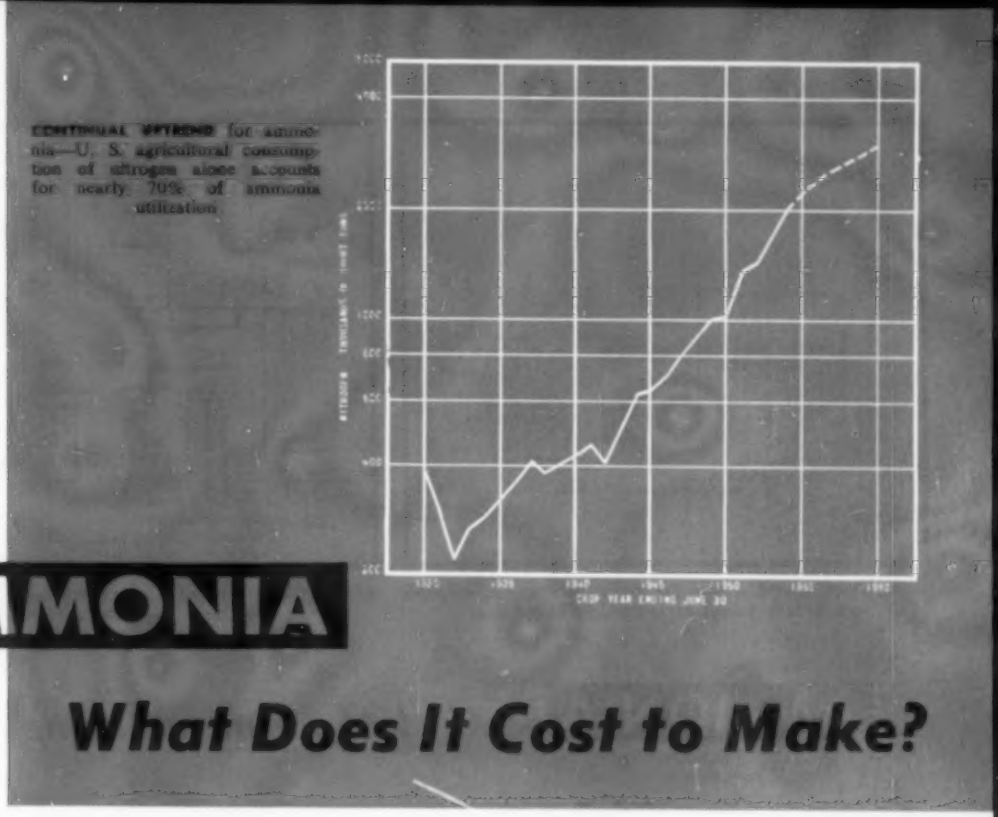


CONTINUAL UPTREND for ammonia—U. S. agricultural consumption of nitrogen alone accounts for nearly 70% of ammonia utilization

AMMONIA

What Does It Cost to Make?

By BARRETT S. DUFF
The Fluor Corp., Ltd.

IN 1887, Thomas Henry Huxley, the English biologist, gloomily forecast the end of western civilization within 50 years due to the exhaustion of available fixed nitrogen.

Fritz Haber and 50,000,000 tons of fixed nitrogen in the form of synthetic ammonia have denied the realization of Huxley's prediction, but the tacit problem is nevertheless continuing and real. In the United States, for example, during the twenty-year interval between 1930 and 1950, a population increase of 28,000,000 was absorbed without an appreciable change in agricultural acreage. This was a period of enlightened farming—increased use of mechanized equipment, hybrid corn, crop rotation, erosion control and a greatly increased production of vegetable protein in the form of the soybean.

Undoubtedly many more advances in farming techniques will increase the productivity of American farmland still further. But will improved techniques permit the feeding and clothing of another increment of 28,000,000 people due in the next ten years? The key to the solution is the availability of essential plant nutrients, particularly nitrogen, in the soil. The crop yield from exhausted land, for example, can frequently be increased two to three-fold by the use of nitrogenous fertilizers. The chart above shows that the farmer is aware of this method of increasing the productivity of his land. From 410,000 short tons of nitrogen in 1940, agricultural consumption in the U. S. jumped to 1,000,000 tons in 1950 and 2,200,000 tons in 1954. And by 1960, the estimated demand exceeds 3,000,000 tons per year.

Agriculture is approximately 70% of the ammonia story. The remaining 30% has interesting facets also. The increased production of synthetic fibers, for example, has been accompanied by a proportional increase in ammonia consumption. Urea plastics, aniline dyes, and organic nitrogen compounds such as the amines have been in much greater demand.

From the foregoing, it is apparent that the manufacture of synthetic ammonia in the U. S. has increased rapidly during the past ten years. It is also indicated that the demand will continue to increase in the next few years surpassing the industry's present production capacity. How will industry meet this increased demand for ammonia? To answer this logically, one must first look at the various routes by which ammonia can be manufactured.

Much depends on your starting point:

natural gas? residual oils? coal? coke-oven gas? reformer gas?

FOR THE DETAILED COST COMPARISONS, please turn the page . . .

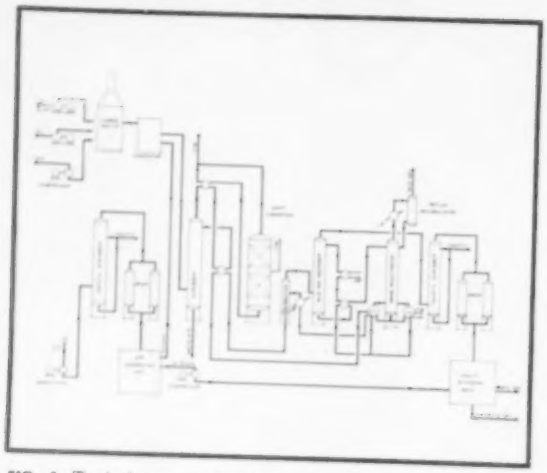


FIG. 1—Typical process flow for producing ammonia synthesis gas by the partial oxidation of hydrocarbons

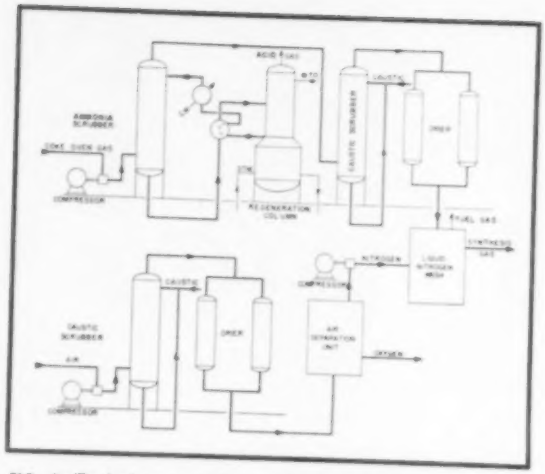


FIG. 2—Typical process flow scheme for producing ammonia synthesis gas from coke-oven gas

AMMONIA —*Cost of Manufacturing from Five*

THE synthesis of ammonia consists of reacting three volumes of hydrogen with one volume of nitrogen. The nitrogen in most commercial processes is obtained from the air. The hydrogen, either pure or mixed with other gases, may be available as a by-product from other processes; or, hydrogen can be manufactured from the various hydrocarbons.

In any event, the cost of obtaining hydrogen in a form suitable for ammonia synthesis is the most important variable in the economics of ammonia manufacture.

The purpose here is to compare the cost of manufacturing ammonia with hydogen obtained from natural gas, residual oils, coal, coke-oven gas, and refinery catalytic reformer off-gas. It is not an object to compare different processes for manufacturing ammonia. Rather, a single process scheme of synthesis gas preparation, purification, and synthesis has been employed in the three cases of hydrocarbon feed and a similar purification and synthesis scheme has been used in the two cases of hydrogen rich by-product gases.

Briefly, the complete process scheme involves:

1—Separation of air into nitrogen and oxygen.

2—The partial oxidation of hydrocarbons to produce carbon monoxide and hydrogen.

3—Reaction of carbon monoxide with water to produce additional hydrogen.

4—Purification of the hydrogen.

5—Synthesis of ammonia from the hydrogen and nitrogen mixture.

In the coke-oven gas and reformer gas cases, the hydrogen is present initially; therefore, steps (2) and (3) are omitted.

Fig. 1 is a typical flow scheme for the production of synthesis gas by the partial oxidation of gas, oil, or coal. Compressed air is scrubbed with caustic for carbon dioxide removal and then dried. The air is then separated by liquefaction into oxygen of 95% purity and nitrogen of 99.99% purity.

The hydrocarbon feed is preheated and partially oxidized with oxygen from the air separation plant. The combustion products from the generator, consisting mainly of carbon monoxide and hydrogen, are charged to the shift converter where the carbon monoxide is converted to carbon dioxide with the production of a mol of hydrogen per mol of carbon monoxide converted. The water required by this reaction is provided by saturation of the gas in the water scrubber plus some steam addition. Following the shift converter, most of the carbon dioxide is removed by absorption in monoethanolamine.

The hot effluent stream from the shift converter is used to supply part of the heat of regeneration of the MEA, thus, reducing the amount of steam required. Final cleanup of CO_2 is accomplished by scrubbing with caustic.

The hydrogen stream now contains only a small percent of carbon monoxide and methane. These impurities are removed by condensation with liquid nitrogen in a low temperature unit.

Part of the synthesis nitrogen is supplied by vaporization of liquid nitrogen in the nitrogen wash unit. Additional nitrogen from the air liquefaction plant is added to the hydrogen to make the synthesis gas mixture of three parts hydrogen and one part nitrogen. The mixture at this point contains less than 100 ppm argon and less than 20 ppm oxygen compounds.

Fig. 2 is a typical flow scheme for processing coke-oven gas. Unlike the partial oxidation cases, coke-oven gas contains a large percent of molecular hydrogen initially and therefore needs only to be purified.

A typical coke-oven gas may contain from 50-60% hydrogen, for example, in a mixture of light hydrocarbons with small amounts of sulfur and oxygen compounds.

The coke-oven gas is compressed to about 350 psi and scrubbed with weak ammonia solution for carbon dioxide and hydrogen sulfide removal. An ammonia solution is preferable to amine because of the presence of certain organic sulfur and nitrogen compounds in coke-oven gas which form non-heat-regenerable compounds with the amines.

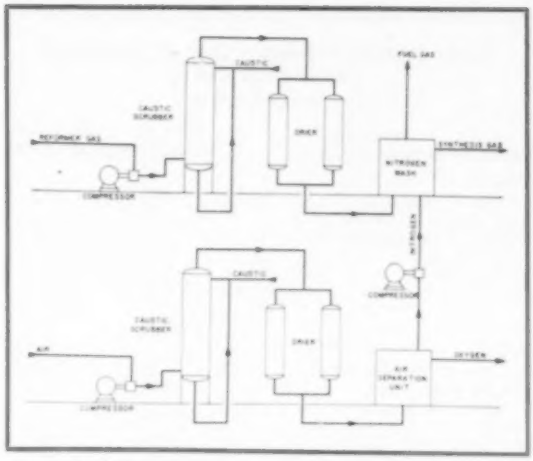


FIG. 3—Typical process flow for producing ammonia synthesis gas from catalytic reformer off-gas

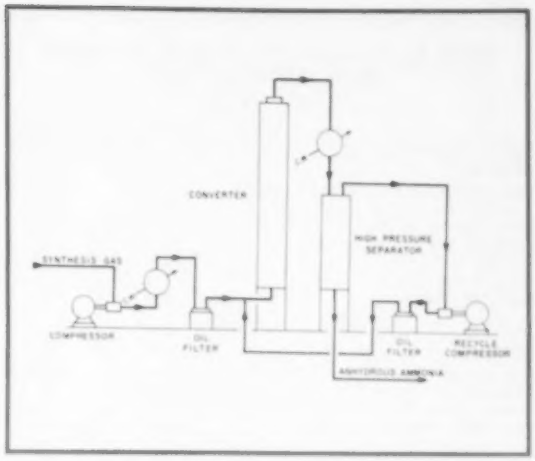


FIG. 4—Typical process flow for synthesizing ammonia from a mixture of pure hydrogen and nitrogen

Different Raw Materials

The ammonia solution is regenerated by the application of heat. Final carbon dioxide removal is accomplished by caustic scrubbing.

Separation and recovery of the hydrocarbons is carried out in a low temperature nitrogen wash unit similar to that used in the partial oxidation process. Methane, ethylene, ethane and heavier hydrocarbons can be recovered separately if desired. The nitrogen is supplied from an air liquefaction unit as in the partial oxidation case, except that the oxygen is usually produced at a lower purity since oxygen is not required by the process.

Fig. 3 is a typical flow scheme for the processing of by-product gas from a petroleum catalytic reforming operation. A high-hydrogen content gas, such as might be obtained from a platinum catalyst unit, has been assumed here to provide a case distinct from the coke-oven gas case. In view of the high hydrogen concentration and low acid gas concentration, the purification of this reformer gas is very easily accomplished by a light caustic scrub and a liquid nitrogen wash. Again nitrogen for the purification unit and for the synthesis mixture is supplied from a standard air liquefaction unit. In either the reformer gas or coke-oven gas case, oxygen of 85% or higher purity is available as a by-product, but this oxygen will be treated as a waste gas in this study.

The synthesis gas mixture produced by each of the five routes is the same—three parts hydrogen, one part nitrogen, about 100 ppm inerts, and less than 20 ppm total oxygen containing impurities.

As shown in Fig. 4, the synthesis gas mixture is compressed to about 600 atmospheres and filtered for oil removal. At the inlet to the ammonia converter, the fresh feed is joined by a recycle stream of unconverted hydrogen and nitrogen. The combined feed stream is heated inside the ammonia converter by heat exchange with the product gases. The hot hydrogen-nitrogen mixture passes through a bed of promoted iron catalyst where the conversion to ammonia occurs.

The effluent gases from the converter are cooled by exchange with water and the product ammonia is condensed and separated from the unconverted gases in a high pressure separator. The ammonia is sent directly to storage and the hydrogen and nitrogen is recycled by means of the recycle compressor.

Table 1—Operating Requirements for Ammonia Manufacture
(Per Ton of Ammonia)

	Nat. Gas	Fuel Oil	Coal	Coke-Oven Gas	Ref. Gas
Gas Feed, MCF	26.0			127	75.7
Oil Feed, Bbls.		4.27			
Coal Feed, Tons			1.28		
Shift Catalyst, Lbs.	0.30	0.35	0.35		
Synthesis Catalyst, Lbs.	0.50	0.50	0.50	0.50	0.50
Caustic, Lbs.	8.0	8.0	8.0	6.0	5.5
MEA, Lbs.	0.30	0.40	0.40		
Lube Oil, Gal.	0.5	0.5	0.5	0.6	0.5
Fuel Gas, MM Btu(1)	22.0	12.0	14.2	—36.7(2)	—4.2(2)
Fuel Oil, Bbls.		2.54			
Fuel Coal, Tons			0.56		
Electricity, KWH	108	120	125	100	80
Treated Water, M Gal.	1.07	1.36	1.50	1.16	
Raw Water, M Gal.	4.5	5.0	5.0	3.2	2.2
Operators Per Shift	7	7	7	6	5

(1) Based on gas-driven compressors.
(2) Includes credit for recovered hydrocarbon gases.

The operating requirements for the five cases are summarized in Table 1. The consumptions shown are based on a complete operating unit including cooling tower, steam generators, product storage and electrical substation. All compressors are gas driven.

The natural gas quantities shown in Table 1 are based on the following composition:

	Mol-%
CH_4	92
C_2^+	6
N_2	1
CO_2	1
	100

The gross heating value is 1040 Btu/SCF.

Table 2—Manufacturing Cost of Ammonia from NATURAL GAS

In Dollars Per Ton

	100 T/SD	200 T/SD
Capital Investment	**$3,950,000.00**	**$6,843,000.00**
Materials		
Natural Gas Feed 31.2¢/MSCF(30¢/MM Btu)	8.11	8.11
Shift Catalyst @ 72¢/Lb.	0.22	0.22
Synthesis Catalyst @ 60¢/Lb.	0.30	0.30
Caustic @ 3¢/Lb.	0.24	0.24
MEA @ 26¢/Lb.	0.08	0.08
Lube Oil @ 80¢/Gal.	0.40	0.40
	9.35	9.35
Utilities		
Fuel Gas @ 30¢/MM Btu	6.60	6.60
Electricity @ 0.8¢/KWH	0.86	0.86
Treated Water @ 13¢/M Gal.	0.14	0.14
Raw Water @ 5¢/M Gal.	0.23	0.23
	7.83	7.83
Other Operating Expenses		
Operating Labor @ $2.25/Man-hr. + 22% Payroll Burden (1)	4.85 (2)	2.43 (2)
Maintenance @ 4% of Capital Investment (3)	4.55	3.94
Plant General @ 40% of Total Labor (4)	3.03	1.92
	12.43	8.29
Fixed Charges		
Depreciation @ 10%	11.38	9.86
Taxes, Interest & Insurance @ 6%	6.83	5.92
	18.21	15.78
Sum of Variable Manufacturing Costs	$47.82	$41.25

(1) Payroll burden covers vacations, insurance and benefits.
(2) Adjusted for 95% operating factor.
(3) Maintenance is 60% labor, 40% material.
(4) Typical, including non-operating service and administrative personnel up to and including plant manager.

Table 3—Manufacturing Cost of Ammonia from FUEL OIL

In Dollars Per Ton

	100 T/SD	200 T/SD
Capital Investment	**$4,098,000.00**	**$7,084,000.00**
Materials		
Fuel Oil @ $1.92/Bbl. (30¢/MM Btu)	8.20	8.20
Shift Catalyst @ 72¢/Lb.	0.25	0.25
Synthesis Catalyst @ 60¢/Lb.	0.30	0.30
Caustic @ 3¢/Lb.	0.24	0.24
MEA @ 26¢/Lb.	0.10	0.10
Lube Oil @ 80¢/Gal.	0.40	0.40
	9.49	9.49
Utilities		
Fuel Gas @ 30¢/MM Btu	3.60	3.60
Fuel Oil @ $1.92/Bbl.	4.88	4.88
Electricity @ 0.8¢/KWH	0.96	0.96
Treated Water @ 13¢/M Gal.	0.18	0.18
Raw Water @ 5¢/M Gal.	0.25	0.25
	9.87	9.87
Other Operating Expenses		
Operating Labor @ $2.25/Man-hr. + 22% Payroll Burden (1)	4.85 (2)	2.43 (2)
Maintenance @ 4% of Capital Investment (3)	4.73	4.08
Plant General @ 40% of Total Labor (4)	3.08	1.95
	12.66	8.46
Fixed Charges		
Depreciation @ 10%	11.82	10.21
Taxes, Interest & Insurance @ 6%	7.09	6.13
	18.91	16.34
Sum of Variable Manufacturing Costs	$50.93	$44.16

(1) Payroll burden covers vacations, insurance and benefits.
(2) Adjusted for 95% operating factor.
(3) Maintenance is 60% labor, 40% material.
(4) Typical, including non-operating service and administrative personnel up to and including plant manager.

The fuel oil quantities are based on a 9° API Bunker "C" with the following ultimate analysis:

	Wt.-%
Carbon	88.3
Hydrogen	9.3
Sulfur	1.1
Ash	1.3
	100.0

The gross heating value is 18,200 Btu/lb.

The coal quantities are based on the following analysis:

	Wt.-%
Carbon	70.4
Hydrogen	4.8
Nitrogen	1.4
Oxygen	5.8
Sulfur	1.8
Ash	14.8
Moisture	1.0
	100.0

The gross heating value is 12,600 Btu/lb.

The coke-oven gas tabulation is based on the following analysis:

	Vol.-%
Hydrogen	55
Carbon Monoxide	5
Hydrocarbons	33
Nitrogen & oxygen	5
Acid gases	2
	100

The gross heating value is 582 Btu/SCF.

The catalytic reformer gas is assumed to have come from a fixed-bed, non-regenerable platinum catalyst unit. Gas from a molybdenum catalyst unit would correspond closely to the coke-oven gas, whereas for the present it is desired to show a case with high hydrogen content gas. The analysis of the gas from the platinum-catalyst unit is as follows:

	Vol.-%
Hydrogen	93.0
Hydrocarbons	7.0
	100.0

The gross heating value is 490 Btu/SCF.

In the coke-oven gas and reformer gas cases, credit is taken for fuel gas recovered from the hydrogen stream in the low temperature unit.

Table 4—Manufacturing Cost of Ammonia from COAL

In Dollars Per Ton

	100 T/SD	200 T/SD
Capital Investment	**$4,248,000.00**	**$7,344,000.00**
Materials		
Coal Feed @ $7.56/Ton (30¢/MM Btu)	9.68	9.68
Shift Catalyst @ 72¢/Lb.	0.25	0.25
Synthesis Catalyst @ 60¢/Lb.	0.30	0.30
Caustic @ 3¢/Lb.	0.24	0.24
MEA @ 26¢/Lb.	0.10	0.10
Lube Oil @ 80¢/Gal.	0.40	0.40
	10.97	10.97
Utilities		
Fuel Gas @ 30¢/MM Btu	4.26	4.26
Fuel Coal @ $7.56/Ton	4.23	4.23
Electricity @ 0.8¢/KWH	1.00	1.00
Treated Water @ 13¢/M Gal.	0.20	0.20
Raw Water @ 5¢/H Gal.	0.25	0.25
	9.94	9.94
Other Operating Expenses		
Operating Labor @ $2.25/Man-hr. + 22% Payroll Burden (1)	4.85 (2)	2.43 (2)
Maintenance @ 4% of Capital Investment (3)	4.90	4.24
Plant General @ 40% of Total Labor (4)	3.12	1.99
	12.87	8.66
Fixed Charges		
Depreciation @ 10%	12.25	10.59
Taxes, Interest & Insurance @ 6%	7.35	6.35
	19.60	16.94
Sum of Variable Manufacturing Costs	$53.38	$46.51

(1) Payroll burden covers vacations, insurance and benefits.
(2) Adjusted for 95% operating factor.
(3) Maintenance is 60% labor, 40% material.
(4) Typical, including non-operating service and administrative personnel up to and including plant manager.

Table 5—Manufacturing Cost of Ammonia from COKE-OVEN GAS

In Dollars Per Ton

	100 T/SD	200 T/SD
Capital Investment	**$3,620,000.00**	**$6,231,000.00**
Materials		
Coke Oven Gas Feed @ 17.5¢/MCF (30¢/MM Btu)	22.22	22.22
Synthesis Catalyst @ 60¢/Lb.	0.30	0.30
Caustic @ 3¢/Lb.	0.18	0.18
Lube Oil @ 80¢/Gal.	0.48	0.48
	23.18	23.18
Utilities		
Fuel Gas @ 30¢/MM Btu	—11.01	—11.01
Electricity @ 0.8¢/KWH	0.80	0.80
Treated Water @ 13¢/M Gal.	0.15	0.15
Raw Water @ 5¢/M Gal.	0.16	0.16
	—9.90	—9.90
Other Operating Expenses		
Operating Labor @ $2.25/Man-hr. + 22% Payroll Burden (1)	4.16 (2)	2.08 (2)
Maintenance @ 4% of Capital Investment (3)	4.17	3.59
Plant General @ 40% of Total Labor (4)	2.66	1.69
	10.99	7.36
Fixed Charges		
Depreciation @ 10%	10.43	8.98
Taxes, Interest & Insurance @ 6%	6.26	5.39
	16.69	14.37
Sum of Variable Manufacturing Costs	$40.96	$35.01

(1) Payroll burden covers vacations, insurance and benefits.
(2) Adjusted for 95% operating factor.
(3) Maintenance is 60% labor, 40% material.
(4) Typical, including non-operating service and administrative personnel up to and including plant manager.

Using the operating requirements given in Table 1 along with typical costs and investments, comparisons have been made for plants designed for 100 and 200 tons/stream day anhydrous ammonia capacities.

The costs shown (in Tables 2-7) include operating offsite facilities such as steam generators, cooling tower, refrigerated storage spheres for 10 days' production, and electrical substation. A synthesis catalyst cartridge change and repair house is included. The costs shown cover all variable investment costs and, therefore, do not include such items as land, fencing, administration building, maintenance shops (other than the cartridge house), roads and rail sidings, which are essentially the same for each of the cases considered.

In selecting values for the feed streams, a common denominator of 30¢/million Btu, gross heating value was chosen. Thus natural gas is valued at 31.2¢/MSCF, residual oil at $1.92/bbl., coal at $7.56/ton, coke-oven gas at 17.5¢/MSCF, and reformer gas at 14.7¢/MSCF. This gives, then, a set of typical energy costs that can be adjusted to reflect other local situations in which one raw material might have an initial cost advantage over another.

In Table 2, costs of manufacturing ammonia from natural gas are shown. The unit costs shown for materials, utilities, and other expenses are typical values applicable in several areas of this country. The material and utility consumptions shown are the same for the two size plants because variations in efficiencies are very slight.

Table 3 illustrates the costs of ammonia from fuel oil on the same basis as the costs for natural gas. Tables 4, 5,

Meet the Author

Mr. B. S. Duff, Development Engineer with The Fluor Corporation, Ltd. of Los Angeles, received a B.S. in Chemical Engineering degree in 1949 from the University of Arkansas. In 1950, he received the S.M. in Chemical Engineering degree from M.I.T. Following graduate study, he worked for Pan American Refining Corporation, Texas City, Texas, in refinery technical service and process design. For the past year he has been with Fluor where the majority of his work has been connected with economic study and process design of ammonia plants. Mr. Duff's original home was Plumerville, Arkansas, and his wife, Peggy, hails from Springdale, Arkansas. They have four children and at present reside in Whittier, California.

Table 6—Manufacturing Cost of Ammonia from CATALYTIC REFORMER GAS

In Dollars Per Ton

	100 T/SD	200 T/SD
Capital Investment	**$2,980,000.00**	**$5,106,000.00**
Materials		
Reformer gas feed @ 14.7¢/MCF (30¢/MM Btu)	11.13	11.13
Synthesis Catalyst @ 60¢/Lb.	0.30	0.30
Caustic @ 3¢/Lb.	0.17	0.17
Lube Oil @ 80¢/Gal.	0.40	0.40
	12.00	12.00
Utilities		
Fuel Gas @ 30¢/MM Btu	—1.26	—1.26
Electricity @ 0.8¢/KWH	0.64	0.64
Raw Water @ 5¢/M Gal.	0.11	0.11
	—0.51	—0.51
Other Operating Expenses		
Operating Labor @ $2.25/Man-hr. + 22% Payroll Burden (1)	3.46 (2)	1.73 (2)
Maintenance @ 4% of Capital Investment (3)	3.44	2.94
Plant General @ 40% of Total Labor (4)	2.21	1.40
	9.11	6.07
Fixed Charges		
Depreciation @ 10%	8.59	7.36
Taxes, Interest & Insurance @ 6%	5.15	4.42
	13.74	11.78
Sum of Variable Manufacturing Costs	$34.34	$29.34

(1) Payroll burden covers vacations, insurance and benefits.
(2) Adjusted for 95% operating factor.
(3) Maintenance is 60% labor, 40% material.
(4) Typical, including non-operating service and administrative personnel up to and including plant manager.

and 6 likewise represent the costs of ammonia from coal, coke-oven gas, and reformer gas.

A recapitulation of the investment and manufacturing costs for the five raw materials is shown in Table 7. The

Table 7—Recapitulation of Investment and Manufacturing Costs

	CAPITAL INVESTMENT		SUM OF VARIABLE MANUFACTURING COSTS	
	Thousands of Dollars		Dollars Per Ton	
	100 T/SD	200 T/SD	100 T/SD	200 T/SD
Natural Gas	3,950	6,843	47.82	41.25
Fuel Oil	4,098	7,084	50.93	44.16
Coal	4,248	7,344	53.38	46.51
Coke Oven Gas	3,620	6,231	40.96	35.01
Reformer Gas	2,980	5,106	34.34	29.34

first two columns are capital costs for 100 and 200 tons per stream day plants in thousands of dollars. The second two columns summarize the manufacturing costs for the same cases on the basis of the selected fuel costs. The reformer gas case is the cheapest in investment and manufacturing costs, and the partial oxidation of coal is the most expensive. However, it must be emphasized that local variations in raw material costs could influence the manufactured costs by as much as seven or eight dollars in some cases.

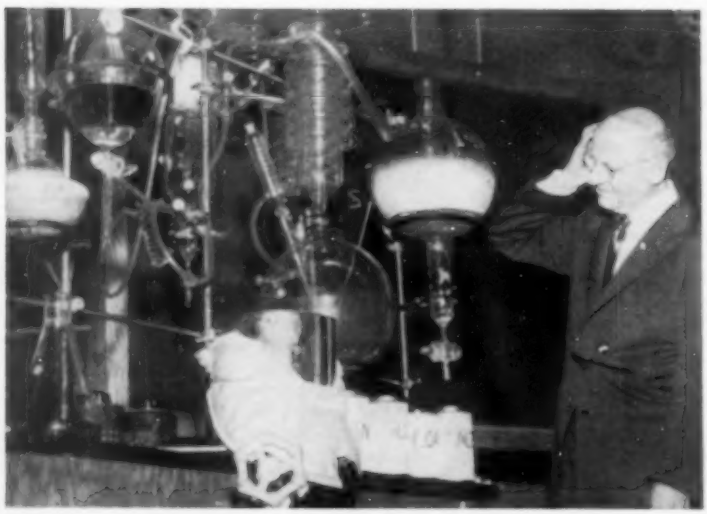
In summary, typical investments and manufacturing costs for the manufacture of ammonia from natural gas, residual oil, coal, coke-oven gas, and petroleum reformer off-gas have been presented. Unit operating requirements have been presented in a manner to facilitate the use of these data to study the manufacturing costs under other local price conditions.

Acknowledgment

The author wishes to acknowledge the valuable assistance given by members of the Engineering Division of The Fluor Corp., Ltd., and to thank The Fluor Corp., Ltd., for permission to publish this paper.

The preceding article is based upon the paper "Economics of Ammonia Manufacture from Several Raw Materials," presented by the author at a sectional meeting of the American Institute of Chemical Engineers in Galveston, Texas, October, 1954.

NEWS in VIEWS



NO PETROCHEMICALS FROM THIS apparatus. Outdoing "Rube Goldberg" himself, friends of Dr. Louis A. Mikeska built this contraption of miscellaneous used scientific glassware as the featured prop for a recent retirement party staged in his honor by colleagues at the Esso Research Center of Standard Oil Development Co. Though Dr. Mikeska has more than 100 chemical patents to his credit, he was obviously mystified as to what he could invent with this unit. It was a spare-time creation which, amid bubbling dry ice and colored liquids, somehow managed to produce a pail of golf balls.

Dr. Mikeska was a senior research associate in the chemical division of Esso Laboratories and has served his company more than 24 years. He conducted exploration work in organic chemistry, including some of the first studies on lubricating oils.

For Petrochemical Makers—

Three New Separation Methods

THREE new developments for separating petrochemicals from process streams were disclosed at the recent 47th Annual Meeting of the American Institute of Chemical Engineers in New York City.

1—Fluid Char Adsorption—by the Standard Oil Development Co.—has graduated from the pilot plant stage with successful separations of light hydrocarbon gases usually requiring high pressures and refrigeration equipment, and is being made available for commercial use.

2—The Rotating Disc Contactor—developed by the Shell Oil Co. for liquid-liquid extractions—is already in commercial use, replacing packed towers and mixer-settler systems.

3—Use of liquid ammonia for solvent extraction—while yet in the pilot plant stage at Pennsylvania State Univ.—shows promise as a useful auxiliary method for separating aromatics and unsaturates from complex mixtures.

1—Separation by Fluid Char Adsorbent

FLUID Char Adsorption (FCA)—for continuous adsorptive separation of gases—is a departure from normal fluidized solids operations which use single large fluidized beds. FCA, instead, depends upon a stage-wise contacting of gas and adsorbent in a plurality of beds arranged as in a conventional bubble-cap tower.

Flexible operation and attractive economics are claimed for the process in the separation of petrochemical streams from refinery residue gases and natural gas, the purification of hydrogen, and the concentration of acetylene from light hydrocarbon combustion or cracking processes.

Satisfactorily demonstrated on a pilot plant scale, FCA uses a fluidized activated char of petroleum origin. The char has properties essentially the same as Columbia G activated coconut carbon, and is said to be cheaper to make.

Pilot plant tests on a refinery residue (fuel) gas—similar to that shown in Table 1—with a 12-in. 6-tray column showed excellent separation of C_1 from C_2 hydrocarbons and of C_2 from C_3 (Table 2).

In the first case, with a feed having a 1.65 ratio of C_1/C_2's, the ratio in the tower bottoms was reduced to 0.042 and the ratio in the tower overhead increased to 42.3. In the second case, with a feed having a 0.802 ratio of C_2's/C_3's, the ratio in the tower bottoms was reduced to 0.065 and the ratio in the tower overhead increased to 39.5.

Control of solids flow through the column is quite smooth, and plate efficiencies (Murphree over-all) of 100% can be expected in commercial operations, as compared to values as low as 10% for oil absorbers. The overhead and bottoms product composition are easily controlled.

Char on-stream activity life is dependent upon the composition of the tower feed. The presence of polymerizable unsaturates penalizes tower performance unless a catalyst reactivation stage is included in the process. Deactivants in the refinery residue gas used during pilot plant runs were mild, and during long runs char activity decreased to 75 to 80% of initial activity, and then reached an equilibrium value.

Excessive amounts of polymerizable unsaturates and pentanes plus components, however, severely depress char activity. Present reactivation methods need further study and improvement before FCA can be economically applied to feed gases having large amounts of activity depressants.

A proposed commercial unit shown in the drawing combines the char "heads" tank, adsorbing tower, char desorber and stripper into a single column with plates for staging in all sections. The commercial design is for the separation of C_1, C_2, and C_3' fractions from the gas mixtures.

The commercial unit functions as follows: adsorption of heavy key (C_2) and heavier feed components in upper tower section . . . enrichment of C_2 fraction (de-methanizing) in rectification section immediately below feed point . . . withdrawal of the C_2 side stream product . . . enrichment of C_3' fraction (de-ethanizing) in lower rectification section . . . withdrawal of wet C_3' product . . . desorption of char by heating and steam stripping in next lower tower section . . . dehydrating hot desorbed char with recycle overhead gas . . . cooling char in bottom section prior to recirculation.

The char is conveyed to the tower

Table 1—Typical refinery residue gas feed to pilot-plant FCA

Component	Mol-%
Hydrogen	12.9
Nitrogen	12.8
Carbon Monoxide	1.6
Carbon Dioxide	3.1
Hydrogen Sulfide	0.6
Methane	28.1
Ethylene	7.5
Ethane	10.3
Propylene	17.7
Propane	4.8
Butylene	0.1
Butane	0.4
Pentanes plus	0.1
Total	100.0

top gas-solid disengaging section by gas lift and the net overhead C_1 product is withdrawn from the recycle lift gas line.

Char reactivation is staged for maximum efficiency with preheated char removed at an intermediate reactivation stage, heated to the maximum temperature by direct contact with combustion gas external to the tower in a lift line, and returned to the reactivator at the withdrawal stage. Combustion gas passes up the tower to preheat the downflowing char and strip any desorbable deactivants to minimize cracking. The hotter char from the withdrawal stage is contacted with steam in the two bottom stages for final reactivation by the water-gas reaction. Hot reactivated char is returned to the desorber heating stage.

Residual char fines and steam are removed from bottoms product and dehydrating gas in two isolated sections of the water scrubber.

The C_3' adsorber product has a high steam content which is partially condensed in the fines removal section to control slurry concentration, with the remainder condensed in the absence of fines. The net fines are recovered and returned to the bottom of the desorber stage of the tower as a concentrated water slurry.

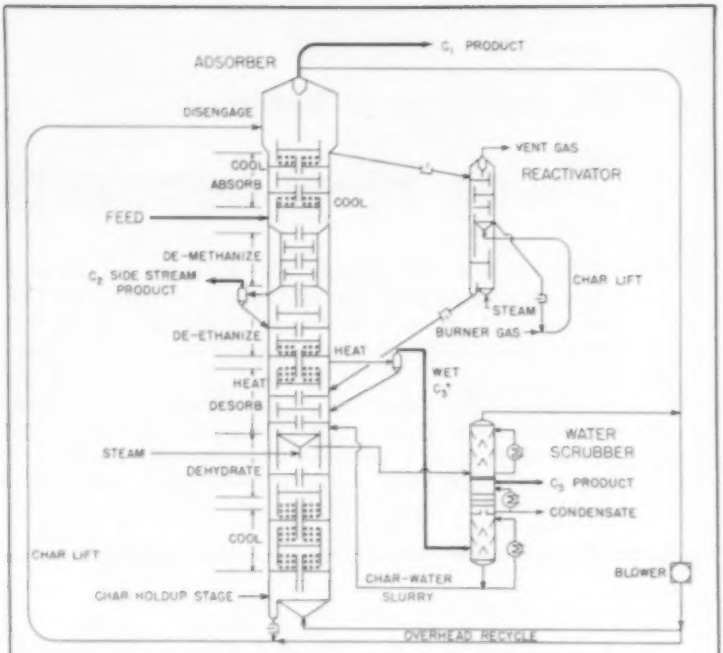
Applications considered promising for commercial use of the FCA process include:

1—Separation of C_2 and C_3' fractions from refinery residue gas and natural gas.

2—Purification of hydrogen in recycle operations or such as derived from hydroforming and ethane cracking for ethylene production—especially when a high purity hydrogen product is desired.

3—Concentration of acetylene produced by partial combustion or severe cracking of light hydrocarbons.

4—Recovery of solvent vapors and other valuable materials present in small concentrations in air and other inert gases.



FLUID CHAR ADSORPTION unit of commercial design

Table 2—Typical FCA separations of refinery residue gas

Desired separation	C_2 from C_2's			C_3 and C_3's from C_3's'		
Tower pressure	70			80		
Feed rate	constant					
Lb. char/SCF feed gas		0.66			0.41	
Gas analyses, mol-%:	**Feed**	**Bottoms**	**Overhead**	**Feed**	**Bottoms**	**Overhead**
Inerts (H_2, N_2 CO)	25.1	0.1	43.8	22.5	0.1	29.4
C_2	27.5	1.6	46.6	30.9	1.0	40.4
C_2's	16.7	38.1	1.1	18.6	5.9	23.7
C_3's'	21.3	50.4	0.1	23.2	90.6	0.6
CO_2, H_2S	9.4	9.8	8.4	4.8	2.5	5.9

5—Gas drying.

6—Recovery of light ends from hydrocarbon synthesis reactions.

The Stone and Webster Engineering Corp. of Boston, Mass. has been authorized by SOD to negotiate nonexclusive licenses for the FCA process.

"Fluid Char Adsorption Process—A New Fluid Solids Development For Difficult Gas Separation" by L. D. Etherington, R. J. Fritz, W. A. Herbst, E. W. Nicholson and H. W. Scheeline, presented at the 47th Annual Meeting of the American Institute of Chemical Engineers, Dec. 12-15, 1954, New York City.

2—Liquid-Liquid Contact by Rotating Disc

A NEW high efficiency, liquid-liquid, extraction apparatus—the rotating disc contactor—for application to the petrochemical, petroleum and chemical industries has been announced by the Shell Development Co. The equipment is claimed to be cheaper to build and more economical to operate than conventional packed tower or mixer-settler systems.

The rotating disc contactor, or RDC, has been in commercial use for purifying crude synthetic detergent solutions, extracting mixed chlorinated hydrocarbon feeds, and extracting lubricating oils with furfural. Laboratory and semi-commercial tests have been conducted on the extraction of mercaptans from gasoline.

Shell has five RDC's in commercial operation: Shell Haven, England; Pernis, Holland (two units); Buenos Aires, Argentina; and Houston, Texas. Another unit is in operation at the refinery of Wintershall A. G., Salzberg, Germany. The Lummus Co. and the Turbo-Mixer Div. of General American Transportation Corp., are licensed to engineer and build RDC's.

RDC units have been built in sizes from 2 in. to 7 ft. 3 in. diameter and up to 25 ft. high. Principle features are a vertical cylinder in which rotates

a central shaft fitted with a series of circular horizontal rotor discs driven by a small electric motor with continuously variable gearing. Rotation speed is usually below 100 rpm.

The center section of the RDC—shown in the drawing—is the countercurrent extractor proper with the rotor discs located midway between the stator rings which are attached to the shell. Small settling chambers are at the top and bottom of the RDC. The liquid interface can be maintained in either the top or the bottom chamber or an external settler may be used.

Operation is at substantially atmospheric pressure in most cases, but moderate pressures up to 70 psig can be used. Development work for high pressure applications is in progress.

The flat smooth rotor plates and stator rings create uniform shearing conditions and a large interfacial area of uniform size—controlled by the rotor speed. This even dispersion is in contrast to the usual uneven size distribution effected by existing equipment, and aids in controlling the extraction of liquid mixtures.

In making synthetic detergent it is often necessary to remove unreacted and polymerized hydrocarbons and higher alcohols from the reaction mixture by extracting with a low-boiling gasoline fraction. As the liquids are contacted, there is a strong tendency to form a stable gel-like emulsion. The use of an RDC with low rotor speeds eliminates this gel formation.

Tests in a 4 ft. 9 in. by 17 ft. RDC showed that efficiency was great enough so that it replaced two 4 ft. by 70 ft. packed columns used for purifying 75 tons/day of crude detergent solution. The RDC erected cost was 45% of the two packed columns.

A mixed chlorinated hydrocarbon feed from which two components are extracted is a job now being performed by a RDC at one of Shell's chemical plants. The system may be classified as one difficult to extract in terms of high density difference and interfacial tension.

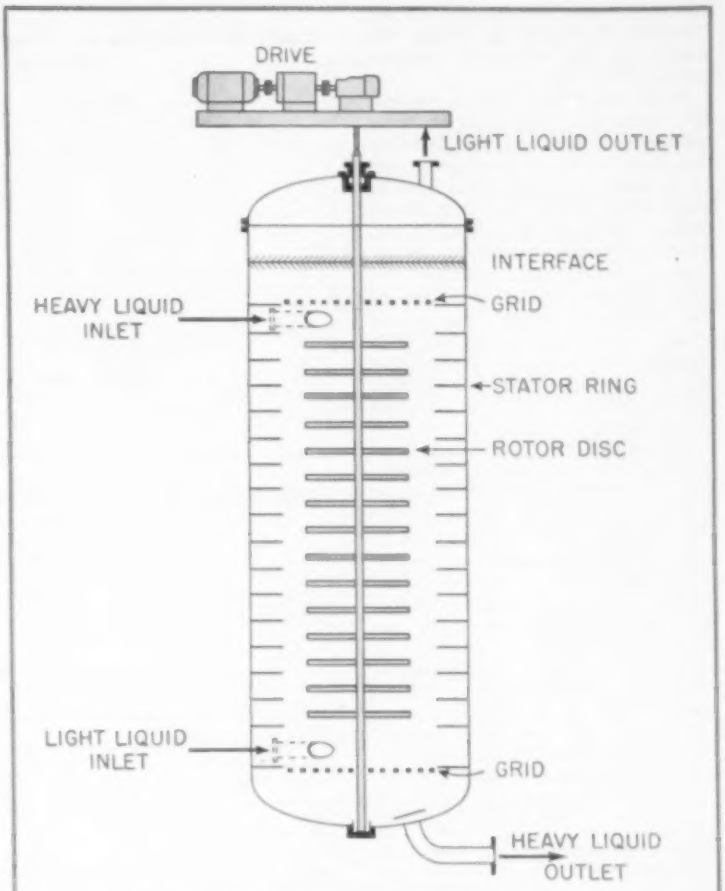
Test run data in a RDC (see Table 3 for specifications) are shown in Table 4. It will be noted that Runs 1-5 show that rotor speed has some effect on the efficiency. Runs 6-9 show that total flow rate (constant solvent ratio) improves the efficiency, while Runs 10-12 show efficiency decreases slightly as the solvent ratio is increased. Run 5 was close to flooding.

Furfural extraction of lube oils is one of the most important solvent refining processes in the oil industry. Seven theoretical equilibrium batch countercurrent extraction stages are the optimum for this extraction. More is of no benefit and less will injure the quality of the extracted lube oil.

To date the only practical apparatus for achieving 7 theoretical extraction stages has been the multi-stage mixer-settler system, one of which was installed by Shell requiring 14 actual stages. Mixer-settler systems are expensive and difficult to operate, but are preferable to packed columns where even a 100 ft. column often will not yield 7 theoretical stages. A packed column also lacks flexibility and efficiency drops as the feed rate drops. In actual practice packed columns approach more nearly 4 or 5 theoretical stages.

Rotating disc contactors used for extracting medium machine oil with furfural were found to give extraction performance the same as or better than a commercial packed column over 100 ft. high. The RDC also allowed higher specific loads (see Table 5) for machine oil and other oils as well.

For the furfural extraction of medium machine oil two RDC's were tested (see Table 6 for specifications), both having external bottom settlers where the furfural phase leaving the contactor settled for about 10 minutes. The settlers were used as backwash (reflux) stages. Variation of the total specific load on the RDC from



ROTATING DISC CONTACTOR as developed by Shell Oil

Table 3—Rotating disc contactor for chlorinated hydrocarbon separation

Diameter of column, in.	24
Diameter of stator ring, in.	18
Diameter of rotor disc, in.	15
Height of compartment, in.	7
Number of compartments	16
Height of settler, bottom, ft.	4
top, ft.	4½
Total height of column, ft.	18

200 to 800 gal./(hr.) (sq. ft.) did not influence the separating power. For spindle oil and deasphalted residue, similar results were noted.

At present, 4 RDC's are in successful commercial operation for the extraction of lube oils with furfural. One RDC, 6 ft. 6 in. diameter by 24 ft. high, has replaced the 14-stage mixer-settler system at Shell Haven Refinery, England. The RDC is estimated to cost 50% less than the mixer-settler system, and valuable solvent hold-up in the RDC is about 10% of the mixer-settler system and solvent losses are reduced by about 30%. Another RDC does the same or better job as a column over 100 ft. high and cost only 30 to 40% as much as the packed column.

The extraction of mercaptans from gasoline fractions is usually inefficient due to the relative physical properties of the gasoline and the extracting caustic or solutizer solution. Packed towers have very low efficiencies, and though mixer-settler systems are better, the equipment is costly and the desired extraction efficiency cannot be obtained economically.

Laboratory and semi-commercial tests on the gasoline-mercaptan system indicate that the RDC can effect a satisfactory and economical removal of the mercaptans. Further tests are being made on this system.

"The Rotating Disc Contactor, A New Tool for Liquid-Liquid Extraction" by G. H. Reman (Koninklijke/Shell-Laboratorium, Amsterdam) and R. B. Olney (Shell Development Co., Emeryville, Calif.) presented at the 47th Annual Meeting of the American Institute of Chemical Engineers, Dec. 12-15, 1954, New York City.

Table 4—Extraction of mixed chlorinated hydrocarbons with rotating disc contactor

Run	Rotor speed, rpm	Flows, gpm Feed	Flows, gpm Solvent	Solvent to Feed ratio	Wt.% extracted from feed of: A	Wt.% extracted from feed of: B	Efficiency Stages/ft. A	Efficiency Stages/ft. B
1	0	3.1	29.2	9.4	46.7	85.9	0.14	0.15
2	160	3.1	29.0	9.4	53.9	90.3	0.19	0.19
3	200	3.1	30.0	9.7	66.3	97.8	0.36	0.31
4	300	3.1	30.0	9.7	.	97.9		0.31
5	400	3.1	30.0	9.7	68.4	97.8	0.41	0.31
6	250	1.8	10.4	5.8	46.5	94.0	*	0.33
7	250	2.7	15.0	5.6	46.0	94.5	*	0.36
8	250	3.6	19.6	5.5	43.1	96.7	*	0.45
9	250	4.0	22.0	5.5	46.6	98.4	*	0.55
10	250	2.0	10.0	5.0	41.0	91.2	*	0.33
11	250	2.0	20.0	10.0	75.0	97.3	0.65	0.27
12	250	2.0	30.0	15.0	90.8	99.0	0.57	0.27

* Pinch region, small extraction factor; the number of stages cannot be calculated sufficiently accurate.
$K_A = 0.080$; $K_B = 0.350$

Table 5—Furfural extraction of lube oil with rotating contactors

Oil	Visc. (Redwood No.1 Secs. at 140°F.)	Packed Column: Furfural rate gal./(hr)(sq.ft.)	Packed Column: Solvent ratio	RDC-2000: Furfural rate gal./(hr)(sq.ft.)	RDC-2000: Solvent ratio
Spindle	50	360	2.0	550	2.0
Medium Machine	250	480	3.0	550	2.0
Deasphalted residue	700	315	4.5	550	3.4

Table 6—Rotating disc contactors for furfural extraction of lube oils

Rotating Disc Contactor	RDC 640	RDC 2000
Diameter of column	2 ft. 1 in.	6 ft. 6 in.
Diameter of stator ring	1 ft. 4 in.	4 ft. 5 in.
Diameter of rotor discs	1 ft. 0 in.	3 ft. 4 in.
Compartment height	4.7 in.	10 in.
Total number of compartments	30	20
Effective height	11 ft. 10 in.	16 ft. 8 in.
Total height	15 ft. 8 in.	22 ft. 2 in.
Rotor speed	60	25
Power input, hp	>>0.1	>1

Note: Operation with furfural as the continuous phase

3—Solvent Extraction by Liquid Ammonia

LIQUID ammonia has been recognized for some time as a useful solvent resembling water in some of its characteristics, but it has not been used extensively to separate hydrocarbons.

Experimental work indicates that liquid ammonia may become a very useful tool for extracting a wide variety of hydrocarbon mixtures. Properly modified, liquid ammonia can effect separations between aromatics and olefins, between olefins and saturates, and in some cases between naphthenes and paraffins.

Anticipated applications are for petrochemicals, octane improvement, making solvents and aviation blending stocks, and in upgrading lube oils.

In use, liquid ammonia requires modification to control its dissolving power which directly affects the solvent's selectivity. This dissolving power varies with different hydrocarbons, but for most cases it must be controlled so that the amount of hydrocarbon in solution lies between 10 and 30 wt.% to give the best results.

Dissolving power is controlled by adding from 0 to 15 wt.% water for a reduction, and from 0 to 50 wt.% monomethylamine for an increase.

It is difficult to find a single solvent with all the desirable properties of solvent selectivity, dissolving power, density, viscosity and interfacial tension which effect the capacity and efficiency of an extractor. Modified liquid ammonia fits well and in addition is applicable to various feed stocks, easy to regenerate, and inert to the mixture to be extracted.

The pilot plant used to test liquid ammonia solvent extraction—shown in the accompanying illustration—has a 20-stage stacked extractor using both stripping and enriching sections. Solvent regeneration is by pressure distillation, since both ammonia and monomethylamine are low boiling. Open steam stripping separates solvent from extract and raffinate. Some water recycles for solubility control.

Liquid ammonia performance in extractions is shown in Table 7. Aromatics recovery from various types of catalytic and thermally treated naphthas is shown in the first four columns

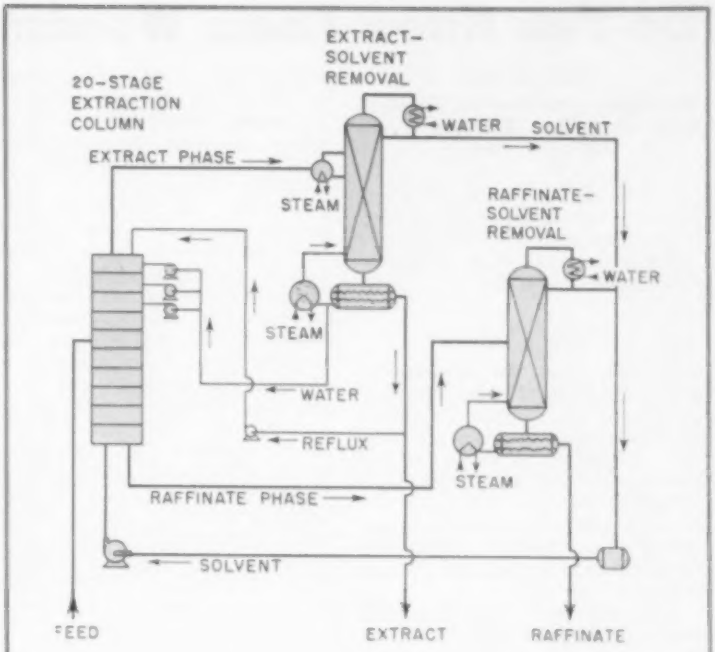
of the table. In addition, the second and third columns indicate the octane improvement obtained from liquid ammonia extraction of naphthas.

Separating olefins in saturates is not easy when feed stocks have a wide boiling range, but results in column five of Table 7 are better than either ordinary or extractive distillation. Narrower boiling stock allows a greater yield and purity.

The separation of aromatics from very high boiling materials is shown in column six of the table for catalytic cycle oil. In this case 83% of the feed aromatics were removed by liquid ammonia extraction.

Other applications, not shown in Table 7 include the reduction of the neutralization number and the removal of highly condensed or cyclic aromatics in Columbian distillates. Liquid ammonia extraction of paraffinic lubricating distillates improves viscosity index, cleanliness, bearing corrosion, and oxidation stability.

[a] Fenske, M. R., McCormick, R. H., Lawróski, H., and Geier, R. G., "Extraction of Petroleum Fractions by Ammonia Solvents" Petroleum Refining Laboratory, College of Chemistry and Physics, The Pennsylvania State University, State College, Penna., presented at the American Institute of Chemical Engineers Meeting in New York, N.Y., Dec. 12, 1954.



AMMONIA EXTRACTION unit, pilot plant flow chart

Table 7—Liquid ammonia extraction of hydrocarbon mixtures

	(1) Catalytic Naphtha	(2) Thermally Reformed Naphtha	(3) Catalytic Heavy Naphtha	(4) Cracked Naphtha Fraction	(5) Dearomatized Catalytic Naphtha	(6) Catalytic Cycle Oil
Feed Properties						
Boiling range, °F.	200-330	100-400	236-458	140-195	195-250	600-1000
Vol.-% Olefins	43	24	16	8	53	
Vol.-% Aromatics	26	25	51	19(Benzene)	1	47
Vol.-%, P + N[b]	31	51	33	73	46	
Research Octane No.		71	87			
Solvent Composition						
Wt.-% Ammonia	80	85	85		68	33
Wt.-% MMA[c]	20	15	15		32	67
Operating Conditions						
E/F/S[d]	12/F/7	8/F/11	8/F/11	12/F/7	7/F/12	4/F/4
Solvent/oil wt. ratio	4.6	5	3	1.6	20	3
Reflux ratio (top extractor)	4.0	0.8	0.7			1
Temperature, °F.	63-72	79-100	68-81	43-66	72-78	88-102
Water injection, wt.-% solvent	0	0	2.5	17.5		4
Raffinate, Vol.-% of feed	62	50	30	85	50	55
Vol.-% Olefins	43	18	12	10	21	
Vol.-% P + N[b]	55	78	88	85	79	
Vol.-% Aromatics	2	4	0	5(Benzene)	0	15
Extract, Vol.% of feed	38	50	70	15	50	45
Vol.-% Olefins	32	21	16	0	86	
Vol.-% P + N[b]	2	19	10	0	12	
Vol.-% Aromatics	66	60	74	99+(Benzene)	2	88
Yield						
% of feed aromatics in extract	94	95	100	78		83
% of feed olefins in extract		55	80		80	
Research Octane						
Raffinate		46	10			
Extract		97	101			

[b] Paraffins + naphthenes
[c] Monomethylamine
[d] Enriching stages/feed point/stripping stages

Do You Know These Words?

By B. H. Weil
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Organosols

Organosols, pronounced "ohr-**gah**-noh-sauls," are colloidal dispersions (suspensions) of fine particles of synthetic resins in solvents, plasticizers or both. When plasticizers alone are used as the dispersant, the term "plastisol" is sometimes employed. Organosols and plastisols differ considerably in properties from conventional plastic solutions, in which the resin is *dissolved* in appropriate solvents.

Organosols are today receiving much attention in the field of protective coatings, especially for the application of PVC (polyvinyl chloride) finishes to automobile parts, ship bottoms, oil field equipment, and dams, and as strippable coatings in "mothballing." Films formed by heating the coated parts to 250-350° F. (at which temperature the resin particles dissolve in the diluents or plasticizers and fuse to a continuous film) are tough, adherent, weather resistant, and retain their gloss. Use of flammable and toxic solvents is greatly reduced or (in plastisols) eliminated. The solvents needed are also less expensive. Moreover, as can be seen, high processing temperatures are avoided.

Petroleum and natural gas enter the organosol field as raw materials for the plastics used, as raw materials for some of the solvents, and (for certain cuts) as the solvents themselves. Polyvinyl chloride, for example, is produced (via vinyl chloride, the monomer) from either acetylene or ethylene, both in turn preparable from petroleum, LPG, or natural gas by cracking, partial oxidation, etc. The solvents employed with PVC include di-isobutyl ketone (a petrochemical) and xylenes or naphthenic thinners, which are refinery cuts from selected crudes or catalytic reformates.

Much research is in progress on the use of organosols for exterior, high-gloss finishes which do not require buffing. It may become possible to apply these materials as a hot spray and fuse the coating in one operation. At any rate, the organosols bid fair to provide solid competition to earlier types of finishes, and to open new markets for petrochemicals.

Cumene

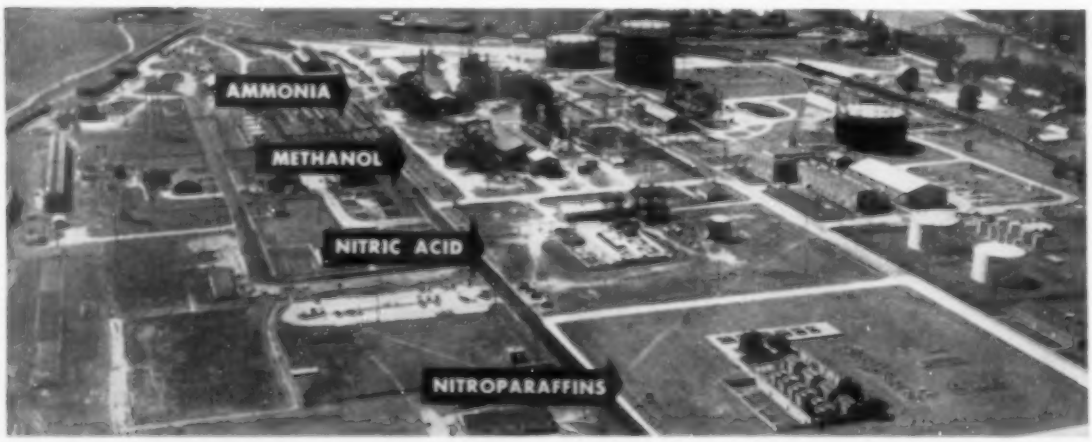
Cumene, pronounced "**cue**-mean," is a petrochemical which most refiners until recently thought of only as a blending agent for aviation gasoline, because of its use for that purpose in World War II. In the past year or so, however, cumene has re-entered the picture as an intermediate used in the joint manufacture of phenol and acetone and as a very real petrochemical, the latter because both of its raw materials—benzene and propylene—are derived from petroleum.

Cumene has the formula $C_6H_5{\cdot}CH(CH_3)_2$, which depicts its chemical name—isopropylbenzene. It is a colorless liquid, insoluble in and slightly lighter than water per unit volume. It boils well above the corresponding temperature for water, and freezes far below the latter's freezing point.

The raw materials for cumene are produced from petroleum in various ways. Benzene, as has often been mentioned in this series, is obtained by separation from the naphtha produced by catalytic reforming of selected stocks, concurrent with the production of high-octane gasolines. Propylene is recovered from refinery cracked gases or is prepared by the dehydrogenation of propane (itself an LPG or LRG).

Cumene production is quite likely to increase; the phenol-acetone manufacturing process in which it is being used is apparently a most attractive one economically. Other uses — as solvent, diluent, etc.—are at present minor, but new ones may be found with the advent of this material as a readily available chemical.

NEWS in VIEWS



NITROPARAFFINS FOR LOUISIANA—A new $5,000,000 unit (in foreground) now building at the Sterlington plant of Commercial Solvents Corp. The first major step in the company's nitroparaffin expansion program, the new facility is being built by Ford, Bacon and Davis Construction Corp. of Monroe, La., and is expected to be on stream next August. Other petrochemical units at the Sterlington plant are indicated by the arrows.

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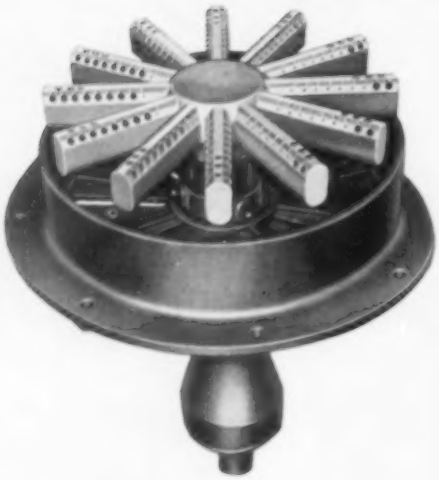

Highest Heat Release per Cubic Foot of Furnace Volume . . .

SERIES VBM

A short flame burner of plain, sturdy construction, the JOHN ZINK VBM VERTICAL BI-MIX BURNER for floor firing gives more heat units per cubic foot of furnace volume—provides extremely even distribution of heat in the furnace and can be used in either wet bottom or dry bottom boilers.

Easy to install, the VBM is normally supplied in sections of two radiating armed spiders with each spider having its own individual mixer—twice mixing the air and gas; first in the atmospheric mixer; second, by the radiating arm jets of the spreader.

Where pressures of 5 pounds or more are available, the JOHN ZINK VERTICAL BI-MIX BURNER will fire boilers and stills at extremely high ratings in small furnaces and with a low draft. *Any gaseous fuel* may be burned, such as refinery gases, natural gas, oil vapor or mixtures without port stoppage. The burners are not damaged by slugs of water, oil or gasoline blowing through or over them. These features combined with ease of control completely eliminate operating difficulties.

ALSO AVAILABLE FOR COMBINATION FIRING

Another JZ Heat Maker

JOHN ZINK CO.

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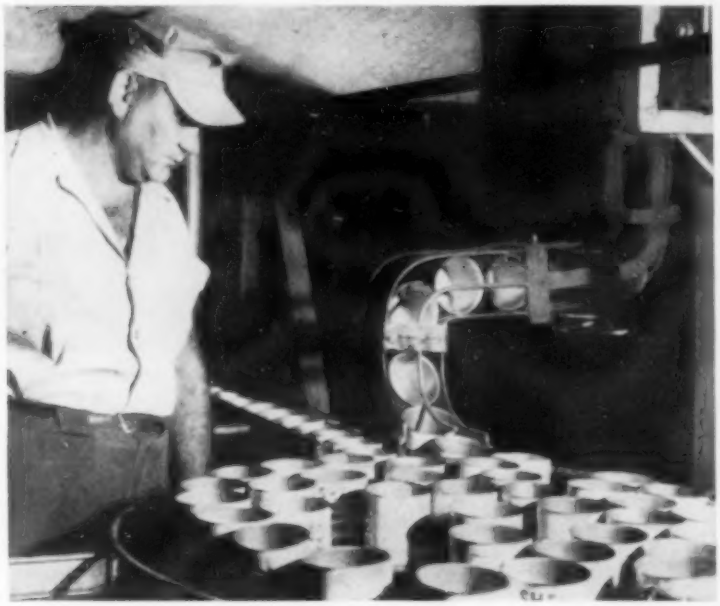

"Unscrambler" Speeds Canning

A MINIATURE "merry-go-round" has brought a substantial increase in canned motor oil production at Shell Oil Co.'s Sewaren, N. J. canning plant. Shell engineers say the invention will work as well in canning soup, beans, or beer as it does in canning oil.

Invented by George Radich, veteran Shell mechanic, the device is a simply-constructed turntable that serves the same purpose as a traffic circle that takes cars from two side roads and feeds them into one main road.

The turntable has broken a bottleneck that existed as long as a canning machine received cans from only one conveyor line. The conveyor moved empty cans from a box car to the canning machine, and the rate of production was limited because of the intermittant flow of cans.

The solution was to unload two or more cars at once with two feeder conveyors, and feed the two lines of cans on to the turntable. The table feeds cans on to a single conveyor that goes to the canning machine keeping the conveyor full of cans and the machine operating at full capacity.

Shell has installed four of these turntables for cans of various sizes. Production, which has risen from an average of 2800 cases of 24 cans each to 3800 cases, is expected to reach 5000 cases a day in 18 months.

The turntable, called an "Unscramble," is a slowly-revolving, flat metal disc about three feet in diameter. The speed at which it turns must be regulated carefully to ensure receiving and discharging cans at the desired rate. An automatic brake guides oncoming cans to the outer edge of the table and keeps them from knocking each other down.

Shell states that they are willing to license manufacture of the Unscramble for general use.

PIPE-FITTINGS MAKE improvised eye-wash fountain

Eye-Wash Fountains Are Plant Made

EXPERIENCE has shown that prompt and continued washing of the eyes is the best possible first-aid when harmful chemicals or bits of foreign matter lodge in the eye. At least 15 minutes' washing is required in some plants before the patient is removed to first-aid (where often the washing is continued). Most important of all, the eye-wash fountain should be readily accessible to employees—and not infrequently this means an outside location, where dirt and debris may fall into the fountain.

Dow Chemical Co.'s Freeport, Texas, plant is one of those requiring a 15-minute washing, minimum, and has installed numerous fountains in outside locations. The particular fountain shown in the photograph is typical, and consists of a globe valve close-coupled to the fountain. The fountain itself is a piece of 2-in. pipe on a reducing nipple, connected by an all-thread nipple to a standard ell turned vertically. A home-made eye cup made from a pipe fitting surmounts the 2-in. pipe.

This arrangement, attached to a water-line, assures copious water flow at a turn of the valve. The large increase in pipe size, however, prevents a high-velocity stream from impinging on the eye.

A strap made from a hose clamp attaches a double-hinged support for the fountain cover. The cover is made of light metal. It is not necessary to remove the cover to use the fountain; it floats off from the force of the water. When the fountain is not in use, the cover over the opening prevents entry of dirt or debris which otherwise might serve to further injure the eye when the fountain is used. There is no lost time in beginning treatment, such as would be the case if the fountain were not protected, or in removing a tightly-fitting cover.

Lined Gage shown with lined blind cover flanges.

WHERE concentration of liquids such as sulphuric, muriatic or other acids necessitates equipment with special linings, Jerguson can furnish you with reflex or transparent gages lined with natural and synthetic rubbers, lead, phenolic base compounds, Teflon, and other materials. Jerguson Lined Gages are designed to meet your requirements of long-life and dependable operation.

To meet your constantly increasing variety of demands, Jerguson engineers, working closely with the men in the Chemical and Petrochemical Fields, have developed a complete line of sound, dependable liquid level gages, valves, and specialties in various metals and synthetics to handle corrosive liquids and gases.

Jerguson Gages keep you out of trouble, and they save you time and money. Send for drawing GD-431 on Lined Gages, or send your requirements.

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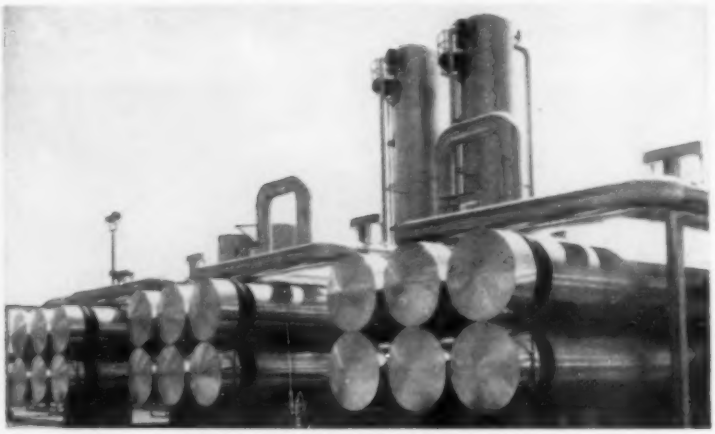

HEAT EXCHANGERS WITH double-insulation and aluminum sheathing

Double Insulation for Savings, Safety

WHILE the operating temperatures in a natural gasoline plant —under 600° F.—permit the use of single layer insulation, the use of two layers provides better temperature control, greater heat conservation, and added fire protection. This is demonstrated at the new Pledger, Texas, natural gasoline plant operated by Southern Production Co., Inc. They have installed double layer insulation on all process vessels and most pipe lines operating above 400° F.

Two layers of insulation with all joints staggered avoid the possibility of through joint openings due to expansion of hot equipment. Outer insulation layers are placed so that both side and end joints are staggered from the under-layer joints.

Process steam reaches the plant at 522° F. and 305 psig. There are also gas-fired heaters from which oil returns to the process by a 14-in. line.

Vessels and heat exchangers below 400° F. have a single layer of 2-in. 85% magnesia blocks or segments. Two 1½-in. magnesia layers are used on equipment over 400° F. Pipe lines are insulated by nominal 1-in. and 1½-in. magnesia sections, applied in single layers to most small diameter pipes and larger pipes with temperatures to about 340° F. Pipe insulation 2-in. thick or greater is applied in two layers, with a maximum of 3-in.

Operators are protected from surfaces 125° F. or higher by 1-in. of insulation.

Application techniques minimize insulation maintenance. Single and double layer block insulation are held in place with 12-gage galvanized wire. Over the blocks there is a first finish coat of insulating cement, then a ⅛-in. coat of asphalt plastic. Vessels are jacketed with 0.024-in. corrugated aluminum, lapped at least 3-in. at seams and fastened with aluminum screws.

Sectional pipe insulation nominal 1-in. and 1½-in. is applied in single layers. Other thicknesses are obtained by using 1-in. and 1½-in. sections in two layers. Each section is secured with at least 3 loops of 16-gage galvanized iron wire. Flanges in oil and hydrocarbon lines are not insulated to prevent damage to insulation during inspection and maintenance of the flanges.

Outdoor pipe lines are jacketed with 0.020-in. aluminum sheets lapped 3-in. at joints with laps downward to shed rain water. Indoor pipe lines are jacketed with 8-oz. sewed canvas.

Thickness of Insulation (nominal inches)

Temp. °F.	Pipes larger than 4 in.	Pipes 2 in. to 4 in.	Pipes less than 2 in.
Below 266	1 in.	1 in.	1 in.
267 - 337	1½ in.	1 in.	1 in.
338 - 387	2 in.	1½ in.	1 in.
388 - 499	2½ in.	2 in.	1½ in.
500 - 599	3 in.	2½ in.	2 in.

For *Long Service* Life

...B&W Carbon Steel Pressure Tubing

The collection of qualities found in B&W Carbon Steel Pressure Tubing, Seamless or Welded, adds up to the all-important end result of long service life.

No less important are the "pre-operating" qualities like uniform ductility, accuracy of dimension and ease of fabrication and installation. Each is a plus that contributes to overall *working* satisfaction from beginning to end use.

Specifically, B&W Carbon Steel Seamless Tubing is available in sizes up to 9⅝ inches outside diameter and B&W Welded is available in sizes up to 4 inches outside diameter. Both in a wide range of wall thicknesses.

As for finishes, seamless is produced either hot-finished or cold-drawn and welded is produced from either hot- or cold-rolled strip.

It meets the applicable specifications of the ASTM, ASME and Government as well as many specifications that may be required for an extraordinary end use.

Where and whenever Seamless or Welded Carbon Pressure Tubing is indicated, make use of B&W's many years in the manufacture of all kinds of tubing. Make *use* of B&W Carbon Steel Pressure Tubing.

B&W SEAMLESS and WELDED TUBES

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

For the complete Carbon Steel Pressure story, write for B&W Bulletin TDC-142. TA-4062B(CP)

Be prepared to meet *any* market condition with Du Pont Fuel Oil Additive No. 2

Flexible refining and blending operations simplify the problem of meeting peak seasonal demands for fuel oil on short notice. The easy way to get this flexibility is through the use of Du Pont Fuel Oil Additive No. 2.

This stabilizer-dispersant makes it possible for you to blend catalytic cracked stocks with straight-run products. As a result you get the manufacturing flexibility to meet varying seasonal demands.

Du Pont FOA-2 also helps you upgrade stocks to increase your yield of domestic heating oils, and release your straight-run stocks for premium diesel fuel or charging stock.

Du Pont FOA-2 helps you improve fuel oil two ways:

1. Retards residue formation—The antioxidant properties of Du Pont FOA-2 effectively reduce the rate of insoluble residue formation in distillate fuel oils.

2. Prevents clogging—If insoluble residues are formed, this additive disperses them so that particles are small enough to do no harm.

Du Pont Fuel Oil Additive No. 2 is most effective when added to freshly prepared stocks at the refinery. Samples for testing in your own stocks and a booklet describing this additive can be obtained from any Du Pont Petroleum Chemicals Division representative or regional office.

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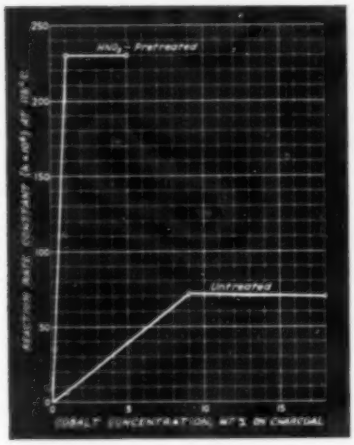
By Peter J. Gaylor, Patent Attorney, Elizabeth, N. J.

Leached Catalyst Shown to Increase Polymerization Rate of Ethylene



POLYMERIZATION rate of ethylene is seen to improve when the charcoal-cobalt catalyst is first leached with nitric acid

NUMEROUS catalysts have been proposed in the past for polymerizing normally gaseous unbranched mono-olefins. In U. S. patent No. 2,692,295, Standard Oil Co. (Ind.) has disclosed a catalyst which is claimed to exhibit extremely high activity in polymerizing such olefins, particularly ethylene, to lower molecular weight polymers.

The invention resides particularly in the development of a leached charcoal in combination with cobalt. As commercially produced, activated carbons are by no means pure carbon and contain about 1-5% by weight of non-carbon impurities, at least some of which act as inhibitors of polymerization. It has been found that when commercially activated carbon is leached with nitric acid, the resulting carbon is characterized by remarkably enhanced activity, as is apparent from the reaction rate curves depicted in the illustration.

For this application, activated charcoals derived from cellulose materials are used, having surface areas in the range of 700-1200 sq. m. per gram, with pore volumes ranging about 0.53 to 0.58 cc. per gram, and pore diameters of about 20 to 30 angstroms. In some instances, these carbons also contain small amounts of combined oxygen.

Treatment with nitric acid (particularly of coconut charcoals) neutralizes the basic materials and leaches out various materials. For example, an activated coconut charcoal leached with 10-40% nitric acid resulted in a removal of 3.8 wt.-% of solids analyzing as follows:

K	23.70
Ca	6.25
P	1.66
Mg	1.45
Si	0.90
Na	0.59
Fe	0.25
Al	0.25
Mn	0.20
Cu	0.01

The catalytic metal may be deposited upon the active carbon support by use of an aqueous cobalt nitrate which then is decomposed at 1-20 mm. of mercury to yield the oxide, which can be reduced with hydrogen. The catalytic metal also may be applied to the carbon by use of the readily decomposable carbonyl.

The process involves contacting an ethylene feed stock, for example, with the nitric acid-leached activated carbon, containing say 1% cobalt, at 10°-200° C. and a weight space velocity of 0.2-2 gm. ethylene per hour per gm. of catalyst at 15-20,000 psig. At pressures above 500 psig, the polymer products fall mainly in the motor fuel boiling range, although some grease-like, tough, solid polymers are also produced. Typical polymers consist of 60% butenes, 24% hexenes, 9% octenes, 5% decenes, and 2% higher boiling products. The butenes consist of about 67% of 2-butene and 33% of 1-butene, with no evidence of isobutene. The hexenes are 30% of 3-methyl pentenes and 70% n-hexene. It is noteworthy that the nitric acid-treated catalyst containing only 1% Co is about 50 times as active as the untreated catalyst containing the same amount of cobalt, at 115° C. Conditions can be selected to produce solid polymer as the main product.

LPG Desulfurized With Mercaptan in Solution

LIQUEFIED petroleum gas with free sulfur present in amounts in excess of about 1 ppm. may be desulfurized by treatment with an alkali metal hydroxide solution containing 0.8-4% by weight of methyl or ethyl mercaptan, according to U. S. patent No. 2,693,443 issued to Standard Oil Development Co. Treatment may be effected in liquid phase with about 30 vol.-% of a 10% NaOH solution containing about 0.8 vol.-% of ethyl mercaptan. Preferred treating temperature is 70°-90° F.

Sonic Waves in Vessels Aid Heat Exchange

MORE efficient contacting of liquids with walls of heat transfer vessels is claimed to be effected by use of an ultrasonic wave generator employing the principle of resonance, according to The Lummus Co. patent No. 2,664,274. No experimental data are submitted, however.

Patents Issued in December

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for December 7, 14, 21, and 28, 1954, Vol. 689, Nos. 1-4.

PROCESSES

Refining

2,696,458 (Standard Oil Development Co.) Deasphalting of residual oils.
2,696,459 (Phillips Petroleum Co.) Separation of oil and wax, using naphtha fraction.
2,696,462 (Socony-Vacuum Oil Co.) Method for regulating the flow of solid adsorbents.
2,696,464 (Phillips Petroleum Co.) Method and apparatus for controlling the separation of conjugated double bond compounds from multicomponent mixtures by extractive distillation using spectrophotometer.
2,696,497 (Phillips Petroleum Co.) Method of removing alkynes from gases with SO_2 in presence of silver contact mass.
2,696,510 (Phillips Petroleum Corp.) Continuous process for absorption-desorption.
2,697,065 (Sinclair Refining Co.) Desulfurizing petroleum distillate fuels with clay in the first stage and liquid sulfur dioxide in the second stage.
2,697,065 (Standard Oil Co.-Ind.) Hydrogen fluoride treating system.
2,697,247 (Standard Oil Co.-Ind.) Wax-handling apparatus.
2,697,682 (Anglo-Iranian Oil Co.) Catalytic desulfurization of petroleum hydrocarbons.
2,697,683 (Shell Development Co.) Desulfurization of hydrocarbon oils by hydrogenation in presence of alumina-molybdenum.
2,698,276-8 (Socony-Vacuum Oil Co.) Solvent extraction.
2,698,279 (Shell Development Co.) Solvent dewaxing of mineral oils.
2,698,282 (Phillips Petroleum Co.) Vacuum distillation of oils.
2,698,321 (Phillips Petroleum Co.) Separation process, using urea, etc.
2,698,350 (Phillips Petroleum Co.) Pebble heater apparatus.

Catalysts

2,696,474 (Standard Oil Co.-Ind.) Method for preparation of alumina organosols and hydrosols.
2,696,475 (Phillips Petroleum Co.) Method of

preparation of supported nickel, cobalt, or copper catalysts.
2,697,066 (California Research Corp.) Method of producing gel-type inorganic oxide catalysts.
2,697,078 (Wighton-Abbott Corp.) Process of regenerating a spent nickel sulfide hydrofining catalyst.
2,697,881 (Phillips Petroleum Co.) Means for displacing hydrocarbon vapors from a fluidized spent catalyst.
2,698,305 (Socony-Vacuum Oil Co., Inc.) Process for controlling pore size of hydrous oxides.

Conversions

2,692,162 (Standard Oil Development Co.) Slide valve adapted for controlling fluidized solids flow.
2,696,460 (Standard Oil Development Co.) Heavy virgin gasoline fraction of improved road O.N., using fluid hydroforming.
2,696,461 (M. W. Kellogg Co.) Regeneration of hydrocarbon conversion catalysts.
2,696,511 (The Babcock & Wilcox Co.) Process for the continuous thermal conversion of liquid and gaseous hydrocarbons by contact with inert solid heat transfer material.
2,697,064 (Universal Oil Products Co.) Desulfurization and reforming of hydrocarbon fractions.
2,697,069 (Godfrey L. Cabot, Inc.) Manufacture of coke from liquid hydrocarbons.
2,697,640 (Houdry Process Corp.) Discharge velocity control for pneumatic lifts.
2,697,653 (Standard Oil Development Co.) Contacting tower for vapors and finely divided solids, including heat exchange means therefor.
2,697,654 (Houdry Process Corp.) Pipe system for guiding contact material between upper and lower zones.
2,697,681 (Universal Oil Products Co.) Hydrocarbon conversion process, involving reforming, deasphalting and hydrocracking.
2,697,684 (Standard Oil Development Co.) Hydroforming of napthas.
2,697,685 (Socony-Vacuum Oil Co.) Method and apparatus for conducting moving contact material hydrocarbon conversion processes.
2,697,686 (Universal Oil Products Co.) Method for effecting the conversion of fluid reactant streams by contact with a moving bed of solid particles.
2,697,688 (Standard Oil Development Co.) Distillation of shale oil-bearing minerals.
2,697,718 (Standard Oil Development Co.) Method of producing gasoline from coal.
2,697,733 (Standard Oil Development Co.) Nonregenerative polymerization process, using phosphoric acid.
2,698,171 (Shell Development Co.) Heat transfer method and apparatus using segregated upwardly and downwardly flowing fluidized solids.
2,698,224 (Phillips Petroleum Co.) Catalyst backflow prevention device.
2,698,281 (Universal Oil Products Co.) Method and apparatus for the continuous contacting of subdivided solid particles successively with at least three fluid reactant streams.
2,698,283 (A/B Svenska Maskinverken) Method and apparatus for the destructive distillation of oil shale.
2,698,284 (Standard Oil Development Co.) Coking of heavy hydrocarbonaceous residues.
2,698,320 (Standard Oil Development Co.) Method for polymerizing with powdered $AlCl_3$.
2,698,351 (Standard Oil Development Co.) Purification of phosphoric acid polymer feed stock.

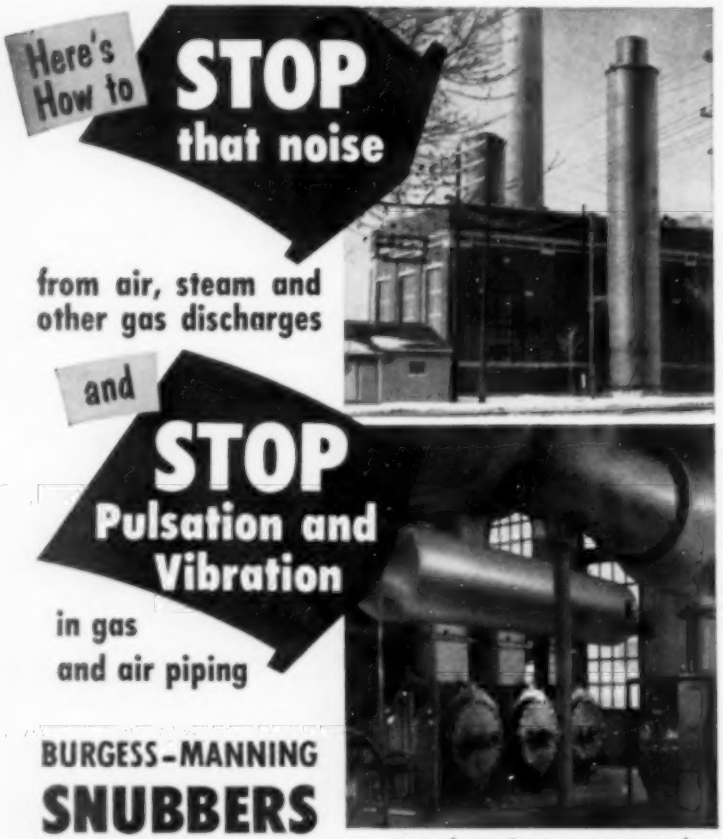
Hydrocarbon Synthesis

2,696,494 (Stanolind Oil & Gas Co.) Extraction of water-soluble organic acids from synthesis products.
2,696,495 (Phillips Petroleum Co.) Separation of oxygenated organic compounds from synthesis products.
2,696,506 (Standard Oil Development Co.) Synthesis of oxygenated organic compounds from CO and hydrogen.
2,696,718 (Hydrocarbon Research, Inc.) Use of thermephore pellets in air rectification.
2,697,655 (M. W. Kellogg Co.) Manufacture of a hydrogen-rich synthesis gas by oxidizing low boiling hydrocarbons.
2,697,696 (Du Pont Co.) Preparation of synthesis gases, using air.
2,698,227 (Du Pont Co.) Preparation of synthesis gases from carbonaceous solids.
2,698,335 (Standard Oil Development Co.) Hydrocarbon synthesis process and catalyst therefor.

PRODUCTS

Chemicals

2,696,306 (Phillips Petroleum Co.) Filter aid in making calcium hypochlorite.
2,696,476 (United Shoe Machinery Corp.) Vulcanizable copolymers of diolefins with a thiophene.
2,696,499 (Richfield Oil Corp.) Preparation of toluic acids from xylenes.
2,696,508 (Standard Oil Development Co.) Isopropanol quality improvement process.
2,697,026 (M. W. Kellogg Co.) Manufacture of hydrazine.
2,697,030 (Universal Oil Products Co.) Apparatus for the manufacture of organic compounds.
2,697,031 (Universal Oil Products Co.) Sulfonation apparatus.
2,697,032 (Phillips Petroleum Co.) Acetylene gas producer using partial oxidation of methane.
2,697,061-2 (Texaco Development Corp.) Processing of hydrocarbons in production of fat-like materials, using molds or yeasts.
2,697,087 (Sun Oil Co.) Compounding rubberlike butadiene polymers with 1, 5, pentanediol diesters.
2,697,091 (Phillips Petroleum Co.) Process for production of alkali metal polysaccharide sulfates.
2,697,114 (Universal Oil Products Co.) Stabilization of organo-siloxanes.
2,697,116 (California Research Corp.) Quaternary taurine-type compounds as surface-active agents.
2,697,121 (Societe Des Usines Chimiques Rhone-Poulenc) Process for the preparation of cumene hydroperoxide.
2,697,122 (The Texas Co.) Process for isolating phenolic compounds from mixtures thereof by extraction with hexamethylene tetramine.
2,697,123 (Olin Mathieson Chemical Corp.) Polychloro-tertiary-butyl-benzenes.
2,697,124 (M. W. Kellogg Co.) Dehalogenation of fluorohalocarbons.
2,697,652 (Phillips Petroleum Co.) Nitric acid plant and control system.
2,697,694 (Standard Oil Co.-Ind.) Manufacture of high molecular weight polybutenes, using ketone-$AlCl_3$.
2,697,700 (Phillips Petroleum Co.) Low temperature emulsion polymerization in polyamine systems containing heavy metal complex activators.
2,697,722 (Standard Oil Co.-Ind.) Manufacture of sulfonic acids by oxidation of sulfur compounds with nitric acid.
2,697,723 (California Research Corp.) Separation of isophthalic and terephthalic acid mixtures, using water.
2,697,730 (Shell Development Co.) Method for producing higher ketones from alcohols.
2,697,731 (Standard Oil Development Co.) Alcohol synthesis process (carbonylation).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There is no obligation for recommendations.
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2,697,732 (Universal Oil Products Co.) O-dealkylation process for aromatics.
2,698,280 (Atlantic Refining Co.) Method of producing a plasticizer for rubber (cat. cracked residue).
2,698,285 (M. W. Kellogg Co.) Separation of organic acids by azeotropic distillation.
2,698,306 (The O. Hommel Co.) Oxidation catalyst in oxidation of unsaturated hydrocarbons.
2,698,310 (Phillips Petroleum Co.) Processing of sulfur-vulcanizable materials containing polymer plasticizer and related compositions.
2,698,316 (Socony-Vacuum Oil Co.) Amine derivatives of copolymers of alpha, beta-unsaturated polycarboxylic acids.
2,698,317 (Celanese Corp. of America) Process for preparing polysulfone resins of olefins.
2,698,329 (Universal Oil Products Co.) Trimethylenedioxybenzene and certain derivatives thereof.
2,698,330 (American Cyanamid Co.) Production of phthalic anhydride and abrasion-resistant fluid catalyst therefor.
2,698,336 (Sinclair Refining Co.) Purification of crude wax oxidates.
2,698,340 (Standard Oil Development Co.) Organic sulfide catalyzed condensation reactions.
2,698,341 (Cities Service Research & Development Co.) Acidolysis of methylal with carboxylic acid anhydrides.
2,698,346 (Stanolind Oil & Gas Co.) Process for preparation of ethanol from acetone.
2,698,347 (Ethyl Corp.) Manufacture of halogen compounds.
2,698,348 (Ethyl Corp.) Halogenation.
2,698,349 (Union Oil Co. of Calif.) Acetylene manufacture from methane and air.

Fuels

2,696,427 (Du Pont Co.) Fuel Oil compositions stabilized against sludging with phenolic triamine.
2,696,428 (Gulf Research & Development Co.) Heterocyclic metal deactivators for hydrocarbon oils.
2,696,708 (Phillips Petroleum Co.) Jet engine operation using fuel containing iron pentacarbonyl.
2,696,806 (California Research Corp.) Removal of combustion chamber deposits in spark-ignition engines, using low octane fuel.
2,696,876 (Sun Oil Co.) Flame failure control for burners.
2,697,033 (Gulf Research & Development Co.) Stable fuel oil compositions containing salt of dialkyl dithiophosphoric acid as sludge inhibitor.
2,697,482 (Foster Wheeler Corp.) Apparatus for combustion of fluid fuel with oxygen.
2,698,008 (Standard Oil Co.-Ohio) Method of reducing the octane demand of engines by introduction of graphite.
2,698,265 (Standard Oil Co.-Ohio) Method of removing carbon deposits from internal-combustion engines by use of pellets of metal with m.p. above 300° C.

Lubricants

2,696,469 (Standard Oil Development Co.) Carbon black lubricating grease.
2,696,470 (Standard Oil Development Co.) Lubricating greases thickened with carbon black.
2,696,471 (Standard Oil Development Co.) Carbon black lubricating grease.
2,696,472 (Monsanto Chemical Co.) Corrosion inhibited lubricating oil, using (tert. alkyl mercapto)-zinc-N, N-dialkyl dithiocarbonate.
2,696,473 (The Texas Co.) Halogen containing extreme pressure lubricant stabilized with a polyalkylene polyamine.
2,697,072 (The Texas Co.) Emulsion type drawing compounds containing carboxyalkyl cellulose salts.
2,697,073-4 (Socony-Vacuum Oil Co.) Turbine oil antioxidants containing reaction product of tetrakis (halomethyl) methane with amine.
2,697,656 (California Research Corp.) Surface-active agents and oil compositions containing them (amino compounds containing long chain alkylbenzyl groups).
2,697,657 (California Research Corp.) Oil-soluble surface-active agents and compositions containing them (alkylaryl sulfonic acids).
2,697,693 (Standard Oil Co.-Ind.) Manufacture of lithium hydroxy carboxylic acid soap greases.
2,698,296 (Standard Oil Co.-Ohio) Process for preparing lubricating oil detergent additive (saponified product of alkyl phenol—P_2S_5—degras).
2,698,297 (Socony-Vacuum Oil Co.) Grease compositions containing copolymer synthetic gelling agents.
2,698,298 (Socony-Vacuum Oil Co.) Lubricating greases containing an acidic copolymer salt.
2,698,299 (Socony-Vacuum Oil Co.) Modified acidic copolymer-fatty acid soap greases.
2,698,300 (California Research Corp.) Greases thickened with acyl ureas.
2,698,324 (Standard Oil Development Co.) Synthetic lubricating oil, reaction product of monocyclic alkyl naphthene with alpha olefin.

Specialties

2,697,075 (California Research Corp.) Dry-cleaning compositions, comprising water-in-oil stable emulsion of Stoddard Solvent
2,697,249 (Standard Oil Co.-Ind.) Method and apparatus for the manufacture of particulate wax and wax objects.
2,697,667 (Shell Development Co.) Asphalt compositions with reduced sweating tendency containing metal naphthenate.
2,697,680 (Phillips Petroleum Co.) Method of using methylol picolines as insect repellents.
2,697,926 (Standard Oil Development Co.) Paraffin wax candle.
2,698,247 (Universal Oil Products Co.) Stabilization of organic compounds with 2, 6-diisobutenyl —, 5-dihydroxynaphthalene.
2,698,309 (Standard Oil Development Co.) Paper coating wax.

Miscellaneous

2,696,083 (Phillips Petroleum Co.) Hydraulic fluid flow control system.
2,696,113 (Standard Oil Development Co.) Method of determining the volume of liquid transferred from a source to a receptacle through an interconnected conduit.
2,696,114 (Sun Oil Co.) Level indicator for granular solids.
2,696,185 (Phillips Petroleum Co.) Liquid cargo barge.
2,696,410 (Gulf Research & Development Co.) Journal bearing.
2,696,650 (Standard Oil Co.-Ind.) Comminuting apparatus for plastic material.
2,696,734 (Standard Oil Co.-Ind.) Viscometer for semifluid substances.
2,696,738 (Standard Oil Co.-Ohio) Liquid level indicator.
2,697,443 (Sun Oil Co.) Pressure relief valve.
2,697,789 (Standard Oil Development Co.) Apparatus and procedure for continuous gas analysis.
2,697,933 (Illinois Testing Laboratories, Inc.) Dew point measuring device.
2,697,934 (Warren Petroleum Corp.) Dew-point testing apparatus.
2,697,999 (Standard Oil Development Co.) Low-pressure warming device.

EQUIPMENT

Processing General

2,696,248 (Morton Salt Co.) Single effect flash evaporator.
2,696,300 (Western Machinery Co.) Drum separator.
2,696,305 (Phillips Petroleum Co.) Continuous adsorption process and apparatus.
2,696,307 (Phillips Petroleum Co.) Continuous centrifugal crystal purifier.
2,696,369 (Bastian-Morley Co.) Heat exchanger.
2,696,893 (Westinghouse Electric Co.) Electrostatic precipitator.
2,696,895 (Research Corp.) Apparatus for separating suspended materials from gas.
2,697,030 (Universal Oil Products Co.) Apparatus for the manufacture of organic compounds.
2,697,031 (Universal Oil Products Co.) Sulfonation apparatus.
2,697,032 (Phillips Petroleum Co.) Acetylene gas producer.
2,697,069 (Godfrey L. Cabot) Apparatus for manufacturing coke from liquid hydrocarbons.
2,697,249 (Standard Oil Co.-Ind.) Apparatus for making particulate wax and wax objects.
2,297,422 (Combustion Engineering) Boiler furnace.
2,697,587 (Fluor Corp.) Controlled temperature, fan-cooled heat exchanger.
2,697,588 (Air Preheater Corp.) Interlocking finned heat exchange envelope.
2,697,653 (Standard Oil Development Co.) Contacting tower for vapors and finely divided solids, with heat exchange means.
2,697,687 (Foster Wheeler Corp.) Apparatus for simultaneously heating a plurality of fluids.
2,697,943 (Bowser, Inc.) Shutoff mechanism for air separators.
2,697,978 (Gordon W. MacIlwaine) Apparatus for extracting liquid from liquid-bearing material.
2,697,979 (Du Pont Co.) Dewatering and compacting press.
2,698,061 (George F. Jaubert) Filtering and adsorbing apparatus.
2,698,131 (De Laval Separator Co.) Centrifugal separator.
2,698,171 (Shell Development Co.) Heat transfer apparatus using segregated upward and downward-flowing fluidized solids.
2,696,282 (Phillips Petroleum Co.) Vacuum distillation of oils.
2,698,283 (A/B Svenska Maskinverken) Apparatus for destructive distillation of oil shale.
2,698,287 (Imperial Chemical Industries, Ltd.) Rotary fractionation apparatus.
2,698,350 (Phillips Petroleum Co.) Pebble heater apparatus.

Catalytic Reactors

2,696,362 (Standard Oil Development Co.) Slide valve adapted for controlling fluidized solids flow

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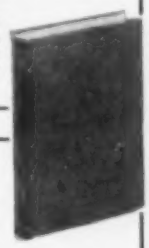

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2,698,281 (Universal Oil Products Co.) Apparatus for contacting of solid particles successively with at least three fluid reactant streams.

Instruments

2,696,114 (Sun Oil Co.) Level indicator for granular solids.
2,696,117 (Minneapolis-Honeywell Regulator Co.) Radiation pyrometer.
2,696,118-9-20 (Minneapolis-Honeywell Regulator Co.) Temperature-indicating device.
2,696,153 (Garrett Corp.) Pressure control mechanism.
2,696,550 (Edwin A. Neugass) Instrument lighting.
2,696,734 (Standard Oil Development Co.) Viscometer for semifluid substances.
2,696,735 (Radio Corp. of America) Vibrating plate viscometer.
2,696,737 (Erdco Engineering Corp.) Magnetic-type flowmeter.
2,696,738 (Standard Oil Development Co.) Liquid level indicator.
2,697,158 (Statham Laboratories) Electric strain gage.
2,697,215 (James Morris, Jr.) Temperature change and fire alarm apparatus.
2,697,350 (A. P. Sorber) Liquid level gage.
2,697,351 (Bailey Meter Co.) Pneumatic telemetering apparatus.
2,697,352 (Pacific Electric Manufacturing Corp.) Transient pressure gage.
2,697,418 (Avery-Hardoll Ltd.) Liquid meter.
2,697,734 (Olin Mathieson Chemical Corp.) Thermocouple protecting tube.
2,697,735 (Lewis Engineering Co.) Temperature-controlled thermocouple cold junction.
2,697,933 (Illinois Testing Laboratories) Dew-point measuring device.
2,697,934 (Warren Petroleum Corp.) Dew-point testing apparatus.
2,697,944 (Douglas Wenham) Liquid flow indicator.
2,698,023 (Minneapolis-Honeywell Regulator Co.) Fluid relay.
2,698,025 (Minneapolis-Honeywell Regulator Co.) Air operated controller.
2,698,111 (William V. Wiley) Fluid flow control mechanism for predetermined volume.
2,698,223 (Cambridge Instrument Co.) Gas analyzer.
2,698,352 (General Motors Corp.) Thermocouple.
2,698,390 (Liston-Folb Instrument Co.) Apparatus for the analysis of mixtures.

Valves & Fittings

2,696,219 (Lilburn S. Barksdale) Fluid valve.
2,696,361 (Philadelphia Valve Co.) Valve.
2,696,363 (Monson Equipment Co.) Valve seat construction.
2,696,831 (Phillips Petroleum Co.) Pressure relief system.
2,696,966 (Mueller Co.) Pipe line stopper.
2,697,443 (Sun Oil Co.) Pressure relief valve.
2,697,599 (Hammel-Dahl Co.) Valve operating mechanism.
2,697,915 (Allen E. Chisholm) Condition responsive two-stage relief valve.
2,697,999 (Standard Oil Development Co.) Low-pressure warning device.
2,698,000 (Charles E. Rainsbury) Signal for pressure-reducing regulators.
2,698,005 (Societe Civile d'Etudes pour Materiel de Fonderie) Remote control for servo mechanisms using periodically actuated valves.
2,698,026 (Fisher Governor Co.) Safety shutoff regulator.
2,698,027 (Robertshaw-Fulton Controls Co.) Combined stop and flow control valve units.
2,698,157 (Oscar H. Ludeman) Alternate manual and automatically operated valve.
2,698,158 (Albert J. Granberg) Slow-seating valve assembly.
2,698,159 (Minneapolis-Honeywell Regulator Co.) Solenoid valve.
2,698,160 (Crane Co.) Valve with plural mechanical movement.
2,698,205 (Bendix Aviation Co.) Control valve.

Pumps & Compressors

2,696,170 (Myron F. Hill) Circulating pump.
2,696,173 (Thormod Jensen) Fluid pump.
2,696,344 (W. Edwards & Co.) Vapor vacuum pump.
2,696,787 (Shockey Corp.) Rotary pump.
2,696,788 (Bendix Aviation Corp.) Variable volume constant pressure pump.
2,696,789 (Alexander S. Sugar) Self-priming centrifugal pump.
2,696,790 (Amos E. Crow) Variable discharge pump.
2,697,402 (Arthur E. Lindquist) Impeller construction for rotary pressure pumps.
2,697,403 (Melba L. Benedek) Hydraulic pump or motor.
2,697,986 (James M. Meagher, Jr.) Axial flow glandless impeller pump.
2,697,987 (Cecil Maddison Barclay) Gear-type pump.
2,698,128 (Joy Manufacturing Co.) Axial flow fan.
2,698,129 (Joy Manufacturing Co.) Multistage axial fan with boundary layer control.
2,698,130 (Novo Terapentisk Laboratorium) Rotary pump or expansion engine.

Miscellaneous

2,696,140 (Continental Can Co.) Heavy duty fiber drum for liquids and semiliquids.
2,696,910 (Chicago Bridge and Iron Co.) Seal hanger for floating roof tanks.
2,697,872 (Robert S. Armstrong) Tube-pulling device.

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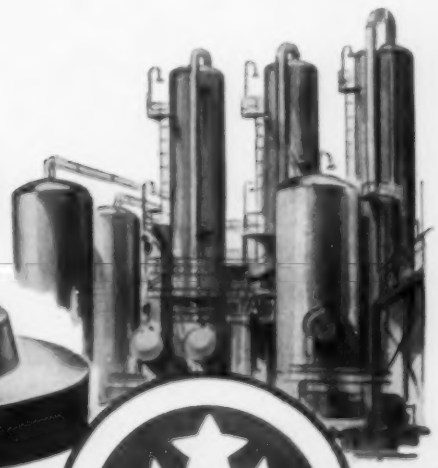

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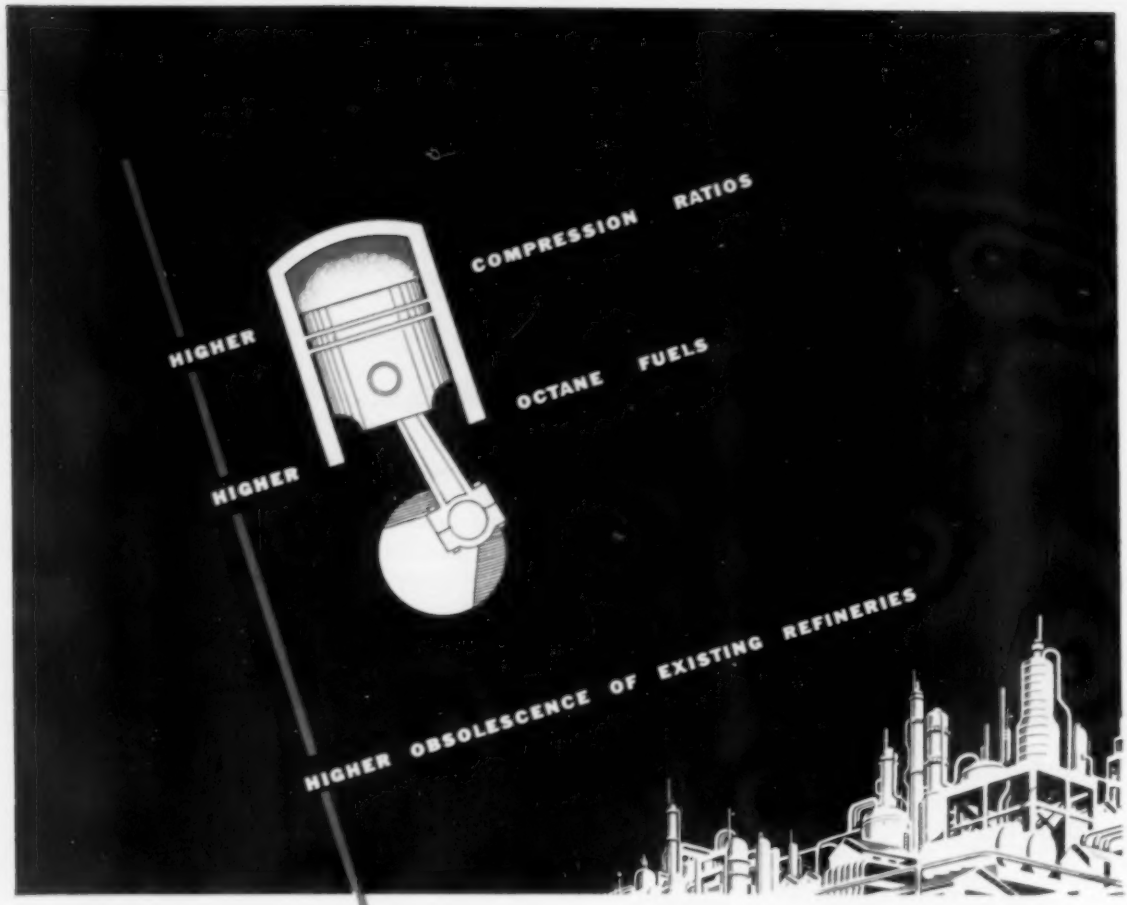

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PERSONALS

WEIGHT-LIFTER Al Goveia, stock and yield clerk at Shell Oil's Montreal refinery, placed second in the North American amateur weight-lifting competition, light heavyweight division, held in Montreal last fall. Here he displays his technique with the help of co-worker Mickey Maguire. Al was champion in his class from 1948 to 1951 in his home country of British Guiana.

Howard L. Minckler, previously a general manufacturing superintendent at the Springfield, Mass., plant of Monsanto Chemical Co.'s plastics division, has been promoted to manager of the Avon, Calif., plant, part of the company's organic chemicals division. He succeeds **Donald J. Miller,** who has been transferred to the post of plant manager of the Mobay Chemical Co.'s New Martinsville, W. Va., plant. The Mobay firm is a Monsanto subsidiary.

Mr. Minckler went to Monsanto in 1941 as a chemist in the analytical laboratories at St. Louis. He moved to the plastics division as an operating supervisor in 1946.

Mr. Miller began working with Monsanto while a student at Washington University in St. Louis. After his graduation in 1941 he joined the research department at Springfield, Mass., and later served there as a supervisor and operating superintendent. In 1950 he was appointed plant manager for the Long Beach, Calif., plant, and in 1952 took the same assignment at the Avon plant.

Herman N. Woebcke has been appointed Mobay's chief engineer. Mr. Woebcke was a group leader in the process design section of Monsanto's research and engineering division prior to joining Mobay. He received his B.S. degree in chemical engineering from Cooper Union in 1938 and an M.S. degree from New York University in 1941.

Mobay's research department has named **Dr. Samuel Steingiser** head of the testing group, with headquarters at the Dayton, Ohio, laboratories until new facilities are completed at New Martinsville, W. Va. Dr. Steingiser was awarded his B.S. degree from the City College of New York in 1938, his master's from Brooklyn Polytechnic Institute in 1941 and his Ph.D. from the University of Connecticut in 1949.

Dr. William M. Burton, 89, retired president of Standard Oil Co. of Indiana, died December 29 in Miami, Fla. He was a collaborator in the development of the first commercially successful cracking process for gasoline.

Dr. Burton was educated at Western Reserve University and Johns Hopkins, taking his Ph.D. degree from the latter school in 1889. He joined Indiana Standard a year later and was the first chemist at the Whiting refinery. He became general superintendent in 1895, a member of the board of directors in 1911, and served as vice-president from 1915 until 1918, when he became president. Dr. Burton resigned the presidency of the company in 1927 but continued in an advisory capacity as a member of the board of directors until 1928. .

In 1918 he was awarded the Willard Gibbs medal of the American Chemical Society, and the Perkin medal of the Society of Chemical Industry in 1922. In 1946 he was honored as a "pioneer in oil cracking" by the American branch of the Newcomen Society of England. He received the American Petroleum Institute's gold medal for distinguished achievement in 1947.

George C. Caine has left the post of general superintendent of Tide Water Associated Oil Co.'s Bayonne, N. J., refinery to direct and coordinate all activities connected with planning, designing and developing the company's projected east coast refinery.

Mr. Caine

Mr. Caine began with Tide Water in 1926 as an engineer in the Bayonne development department. He was shifted the following year to the paraffin and lubricating department, and in 1931 became assistant process superintendent. He became the refinery's assistant general superintendent in 1938 and general superintendent in 1943.

The new manager of Tide Water's public relations department is **Charles N. Pollak** previously Pacific Coast editor of *National Petroleum News, Oilgram News Service* and PETROLEUM PROCESSING. He has also been managing editor of *Petroleum World and Oil* and a lecturer on Latin Amer-

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ica at the University of Southern California. His headquarters with Tide Water are in San Francisco.

Herbert G. M. Fischer has been appointed manager of Standard Oil Development Co.'s new office of refinery liaison. This unit is responsible

Mr. Fischer

Dr. Richardson

for contact with management and technical representatives of refineries, here and abroad, for which the company does research and engineering. Mr. Fischer joined Jersey Standard in 1922 and SOD in 1933.

Associate manager of the liaison office is **Dr. Roger Richardson,** formerly associate director of the Esso Laboratories at Baton Rouge. He joined the company in 1933.

The new associate director of the Baton Rouge laboratories is **Dr. Robert W. Krebs,** previously an assistant director. He began with the Esso Labs in 1937 and was promoted to assistant director in 1947.

The number of assistant directors at the Esso Labs has been raised to five and the following men promoted to that post: **Dr. Lindsey L. Griffin, Jr., Frank B. Johnson, Charles N. Kimberlin,** and **Dr. Robert E. Wood.** Dr. Wood is an acting assistant director. **Edward W. Nicholson,** an assistant director, is currently on a rotational training assignment with the Baton Rouge refinery.

Two new divisions have been formed out of the old SOD development division. The first of these, the chemicals development division, has **Harold W. Scheeline** as director, and the second, the petroleum development division, is headed by **C. Wesley Tyson.** Dr. Scheeline has been an assistant director of the old division since 1947.

Mr. Tyson is currently on a training assignment with Esso Standard Oil and **Arnold F. Kaulakis** has temporarily taken his new post. Mr. Kaulakis, along with **Henry Ogorzaly,** has a permanent assignment as assistant director of the petroleum development division. **Stanley E. Jaros** has been named assistant director of the chemicals development division.

The new director of the SOD proc-

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Second in a series of advertisements designed to show new opportunities in heat exchange.

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Trufin Type S/T has integral fins squeezed directly from the tube wall and is specifically designed for shell and tube heat exchangers. One of its most ideal applications is found in propane condensing operations.

Study the six Trufin features listed at left. They emphasize Trufin's unique construction and show how to bring new heights of efficiency and new economy to heat exchangers and condensers.

Processing engineers are discovering—in Trufin—the help they need to keep pace with today's soaring production demands.

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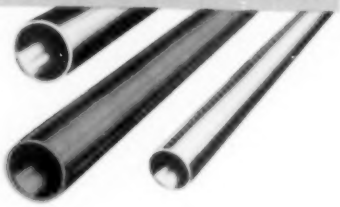
Trufin Type S/T is only part of the complete line of condenser tube products at Wolverine. Here is the rest of the cost-saving lineup:

PRIME SURFACE TUBING



To meet varied corrosive conditions Wolverine produces prime surface tubing in a complete size range in copper, copper-base alloys, aluminum and electric-welded steel.

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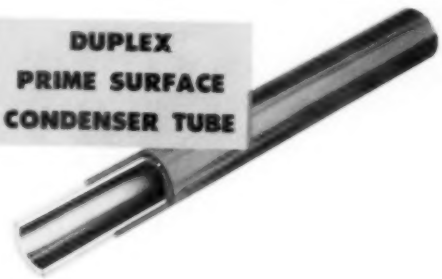

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DUPLEX TYPE S/T

Duplex Type S/T not only withstands two different types of corrosion, but because of its integral fins it also boosts heat exchanger capacity. It has a plain end slightly larger than the O.D. of the fins to simplify rolling into headers.

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ess division is **Homer Z. Martin,** previously assistant director of the research division and, before that, assistant director of the development division. **Burton C. Belden** is the new associate director. Dr. Belden has been with SOD since 1936.

E. E. McPherson, manager of the Pure Oil Co.'s Heath refinery since 1920, is now in an advisory status with the company. He has been replaced as refinery manager by **David P. Hankins,** assistant manager of the refinery.

Mr. Hankins

Mr. McPherson arrived at the Heath refinery just 12 days before it began operations and has spent his entire employment at that location. He was first a shell still foreman, then successively cross still operator, assistant superintendent, superintendent and manager.

Mr. Hankins has been in Pure Oil's refining division for 30 years. His job before his newest assignment was superintendent of the Cabin Creek refinery in West Virginia. He was transferred to Heath two years ago.

John A Field has been named vice-president of Carbide and Carbon Chemicals Co. with responsibility for sales development and related activities, including the company's fellowship program at the Mellon Institute, Pittsburgh.

Mr. Field received his B.A. degree from Yale University in 1935 and subsequently attended Oxford University on a fellowship. He joined Carbide in 1936 as a unit foreman in the production of new chemicals. He conducted research at Mellon Institute from 1939 to 1940. After the war he was made the company's product manager in the fine chemicals department, becoming assistant manager of the department in 1952.

Mr. Field's associate in his development work will be **Dr. R. L. Bateman,** director of product development and previously manager of the fine chemicals division. Dr. Bateman's successor in fine chemicals is **W. A. Woodcock. Dr. R. H. Wellman** has been appointed manager of the agricultural chemicals division.

John S. Thompson, superintendent of Sun Oil Co's Marcus Hook refinery since 1952, has been appointed super-

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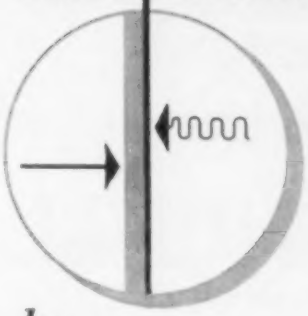

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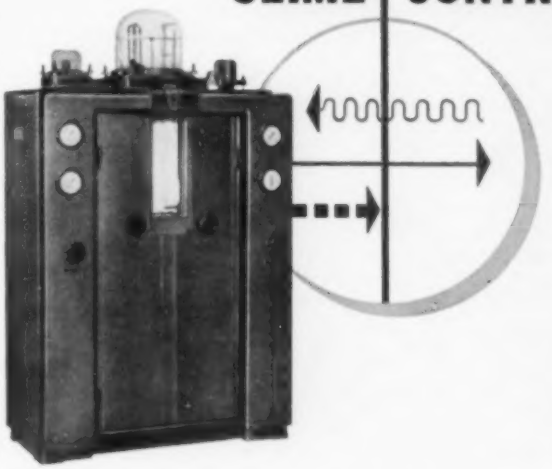


Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

(To obtain more data on advertised products see page 264)

Progress Report

to users and prospective users of

NATIONAL

(CAST IRON)

R. N. SPECHT
Manager

COOLING AND CONDENSING SECTIONS

The following new developments in National Cooling and Condensing Sections are announced in the interest of effecting further operating economies and performance value:

1. SHOP ASSEMBLY. National Sections, while easily and economically assembled in the field, can now be shipped assembled in stacks, tested and ready for use, at surprisingly little extra cost. This now applies to domestic shipments as well as for overseas.

2. PROTECTIVE COATINGS. For services where cooling water is excessively corrosive or fouling, National Sections coated with recently developed Kolmetal have proved to be unsurpassed in increasing life and long range efficiency plus reducing maintenance costs for cleaning to virtually zero.

3. EVAPORATIVE OPERATION. It is now a proved fact that National Sections can be operated as a combination exchanger and cooling tower, with excellent approaches between ambient wet bulb and final product temperatures.

4. FURTHER RESEARCH. Now under consideration and development are several new materials from which National Sections may be cast, in addition to currently available close grained gray cast iron and chrome nickel iron. These developments will be of particular interest in connection with the handling of flammable fluids. Further announcements in this field will be forthcoming soon.

These new developments plus the fact that National Cooling and Condensing Sections are performing in many industrial, chemical and oil field and refining applications with high efficiency and with minimum maintenance prove that it pays to consult with National about your cooling and condensing problems. Write for our latest Bulletin CEC-54.

THE HEAT TRANSFER DIVISION
NATIONAL
RADIATOR (NRC) COMPANY
JOHNSTOWN, PENNSYLVANIA

HEAT TRANSFER DIVISION HEADQUARTERS
60 EAST 42nd STREET, NEW YORK, NEW YORK

intendent—coordination. He took his B.S. degree in engineering from Princeton University in 1927 and received a chemical engineering degree one year later. Mr. Thompson started with Sun Oil in 1931 as an engineer in cracking plants at Marcus Hook.

The refinery's new superintendent of operations is **C. Calvin Naylor,** previously assistant to the refinery manager. Mr. Naylor joined the company in 1934 in the crude oil testing laboratory of the research and development department following his graduation from Pennsylvania State University with a B.S. in chemistry.

The former assistant superintendent in charge of blending and packaging at Marcus Hook, **A. Earle Creamer,** has been promoted to superintendent. He has been working for Sun Oil since 1912, when he began in the barrelhouse, then was transferred to the refinery laboratory. The new assistant superintendent of blending and packaging is **W. Harlan Taylor,** who was the blending and packaging division's operating assistant. He started with the company in 1925 as an electrician's helper.

William A. Casey has been appointed assistant to the refinery manager, W. T. Askew. A 1939 graduate of the Drexel Institute of Technology, where he earned a B.S. in chemical engineering, Mr. Casey subsequently took two years' post-graduate work in physical chemistry at Rutgers University. He then joined Sun Oil's research and development department as a chemical engineer. In 1953 he was appointed manager of the department's technical service division.

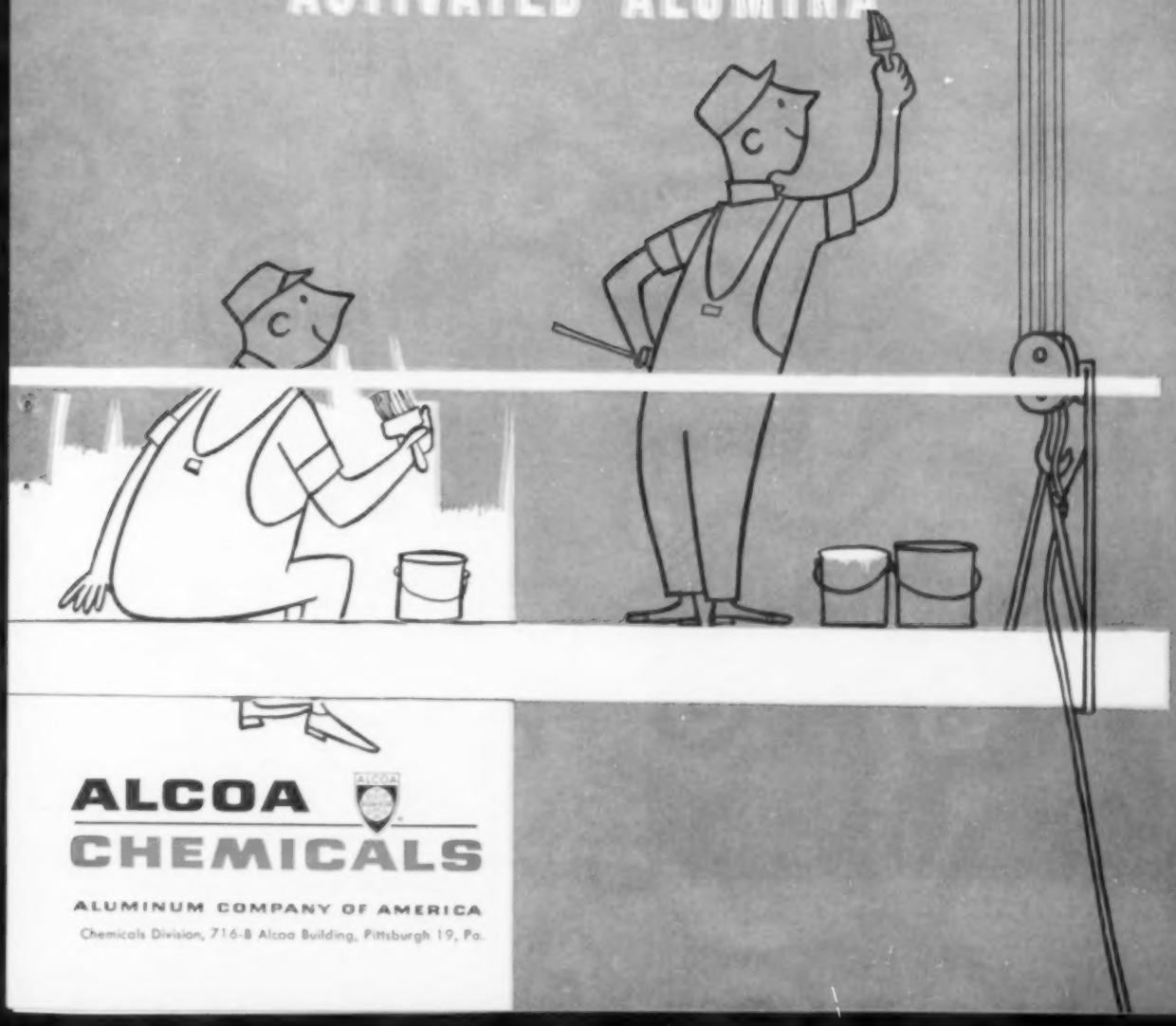
James T. Rothenberger has been promoted from assistant to general maintenance superintendent at General Petroleum Corp.'s Torrance, Calif., refinery. Mr. Rothenberger joined the company as a roustabout in 1933 and since then has worked at both the Vernon and Torrance plants for the engineering department. He replaces B. C. McCoy, who has resigned.

C. F. William Gebelein has been appointed technical director of the petroleum sulfonate department of Pennsylvania Refining Co., Butler, Pa. He was formerly with Esso Standard Oil Co., which he joined in 1941.

J. W. Miller has been elected executive vice-president and director of Brea Chemicals, Inc., a subsidiary of Union Oil Co. of Calif. Mr. Miller was formerly Union Oil's southwest territory manager.

(To obtain more data on advertised products see page 264)

No other commercial desiccant dries to lower dew points than ALCOA ACTIVATED ALUMINA



ALCOA CHEMICALS

ALUMINUM COMPANY OF AMERICA

Chemicals Division, 716-B Alcoa Building, Pittsburgh 19, Pa.

HOUDRIFORMING gives HIGHEST YIELDS in Gasoline Upgrading

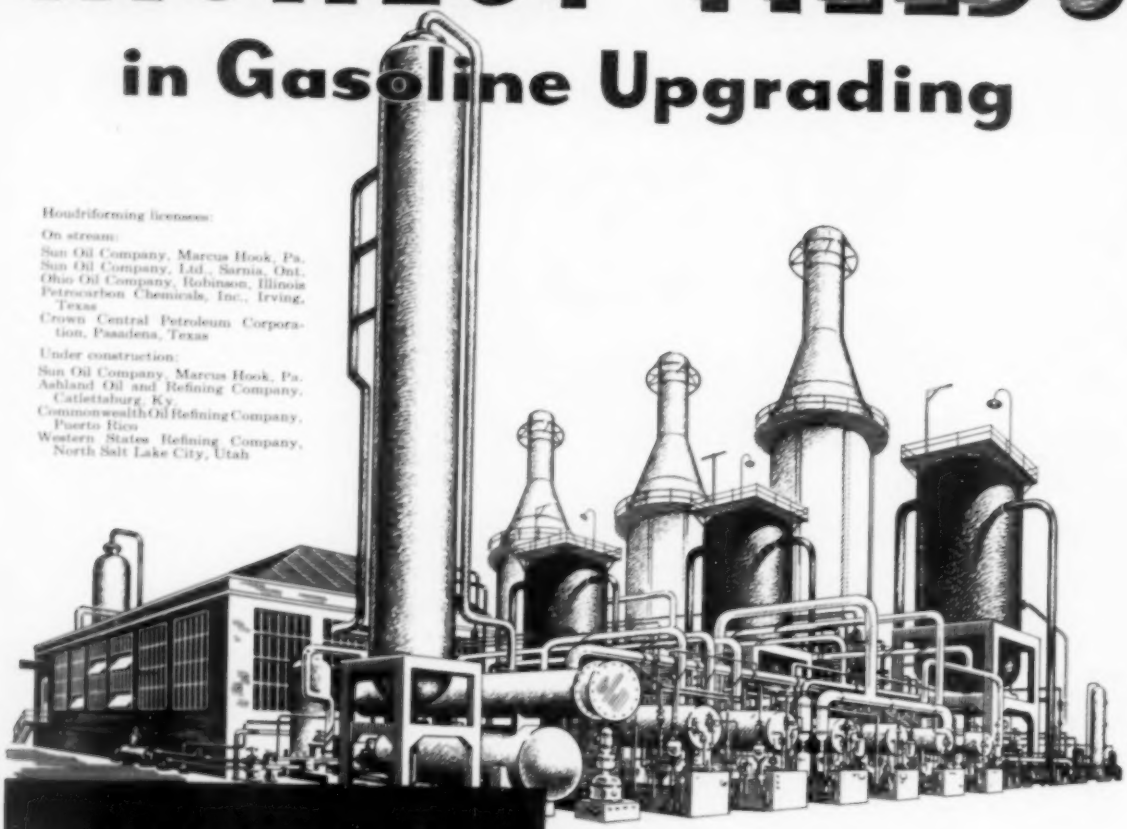
Houdriforming licensees:

On stream:

Sun Oil Company, Marcus Hook, Pa.
Sun Oil Company, Ltd., Sarnia, Ont.
Ohio Oil Company, Robinson, Illinois
Petrocarbon Chemicals, Inc., Irving, Texas
Crown Central Petroleum Corporation, Pasadena, Texas

Under construction:

Sun Oil Company, Marcus Hook, Pa.
Ashland Oil and Refining Company, Catlettsburg, Ky.
Commonwealth Oil Refining Company, Puerto Rico
Western States Refining Company, North Salt Lake City, Utah



HOUDRY
PROCESS CORPORATION
1528 Walnut Street, Philadelphia 2, Pa.
International Representative: World Commerce Corporation, S.A.
PIONEER IN CATALYTIC PROCESSES

Houdriforming catalytic reforming process answers the increasing demand for higher octane motor fuels. Also, this process gives exceptionally high yields of benzene, toluene, and xylenes as well as high octane gasolines and aviation base stocks. Houdriforming is a continuous process, completely flexible.

There are now five Houdriformers on stream, four more are under construction. Among the many features of Houdriforming are longer catalyst life and the restoration of catalyst activity by regeneration *in place*.

Write on your letterhead for a new brochure describing the Houdriforming process.

(To obtain more data on advertised products see page 264)

Succop to Build Two TCC Plants

Negotiations have been completed for the erection of two Succop TCC plants, according to C. E. Succop, president of the new Succop Refinery Engineering Co., Los Angeles.

One plant will be built in Oklahoma and the other in Canada. Names of the purchasers will be revealed when contracts are signed early in 1955.

Mr. Succop said his firm is negotiating with Pemex for the construction of several other units in Mexico.

The Succop plant utilizes the Socony-Vacuum TCC process under license. The design enables the plant to be built as a self-supporting structure, eliminating external support and thus affording a saving of 600,000 pounds of structural steel.

Mr. Succop told PETROLEUM PROCESSING that his plant could be built, under normal field conditions, for about $300 per bbl. of capacity against $570 per bbl. for a conventional plant. This is equivalent to almost a $500,000 savings on a 7500 b/d unit. Erection can be completed two weeks after materials reach the site, against four to six months for a conventional unit.

Mr. Succop, who worked on 11 different TCC installations while with Fluor Corp., Ltd. and Ralph M. Parsons Co., organized his own company in January, 1954. He has been engineering and pilot-testing his new process since then. Dr. John D. Keye and H. J. Succop, Sr., are vice-presidents of the firm.

New Units Formed by Du Pont

To prepare for new developments in the field of petroleum additives and to increase its customer service, the Du Pont Co. has created a new additive sales section and a new technical service group within the petroleum chemicals division. In addition, new sales districts have been formed in the middle Atlantic area with offices in Philadelphia, and in the middle west with offices in Detroit.

The new additives sales group is located in Wilmington and is headed by R. M. Glover, formerly manager of the division's mid-continent region. The technical service group operates from the petroleum laboratory at Deepwater Point, N.J. W. E. Bettoney, who was previously an assistant technical manager of the division in Wilmington, is manager and assistant director of the laboratory.

L. Z. Carey, who was a sales representative in the eastern region office, has been appointed manager of the Philadelphia district. The new Detroit office has been established to improve customer service and maintain close contact with the automotive industry. One of the division's automotive experts, P. H. Richard, has been named manager of this new district. Another change in the sales staff is the promotion of D. W. Frison from assistant manager of the mid-continent region to manager. He has B. B. Russell III, formerly division additives' coordinator, as his assistant.

Isotope Firm Opens Houston Lab

A commercial laboratory set up to supply isotope tracers to the oil industry has been established in Houston by Tracerlab, Inc., a firm that makes radiation detection instruments and prepares radioactive materials. Oil exploration, drilling, and transportation operations, as well as refining, now provide the major industrial uses of isotopes, according to a Tracerlab spokesman. This trend is expected to continue because of the new firm's accessibility to the center of the industry, which will make it possible to use some of the short-lived isotopes in experiments.

Tracerlab, Inc., is located at 2419 South Boulevard, and operations are headed by Leonard F. Tischler, a radiochemist formerly with the company's Richmond, Calif., laboratory.

Portland to Have Fittings Factory

A new factory to make welding fittings will go up in Portland, Ore., as the result of an agreement between Zidell Machinery & Supply Co., of that city, and Clyde Tube Forgings Ltd. of Glasgow, Scotland.

A new corporation has been established to operate the plant. Known as Clyde Tube Forgings of America it plans to have the new factory in operation by May. Equipment and machinery, now being manufactured in Glasgow, will be housed in a 65x400-ft. steel building to be erected on property owned by the Zidell firm. Sam Zidell will be chairman and Emery Zidell president of the organization.

Kaiser Plans Storage Expansion

A structural steel building for pipe and structural shapes costing $1,150,000 will be added to Kaiser Steel Corp.'s mill warehousing facilities at Fontana, Calif.

The warehouse's ability to stock a more diversified line of mill products and thus fill demand for these items more quickly is one of the benefits expected from the expansion. Construction will begin early in 1955.

Phillips Moves to Howe-Baker

Robert J. Phillips, formerly editorial director of *Petroleum Refiner*, returned to engineering recently when he joined the Howe-Baker Corp. as manager of the treating division. Howe-Baker designs and manufactures electrical desalting and treating equipment for the refining industry. Mr. Phillips will also work in process engineering for the desalting division.

Mr. Phillips took his education in chemical engineering at the University of Texas. On graduation, he joined the technical service division of Humble Oil and Refining Corp.'s Baytown refinery. His first job in publishing was as a department editor for Gulf Publishing Corp., where he began in 1952.

Diamond Building Radiation Lab

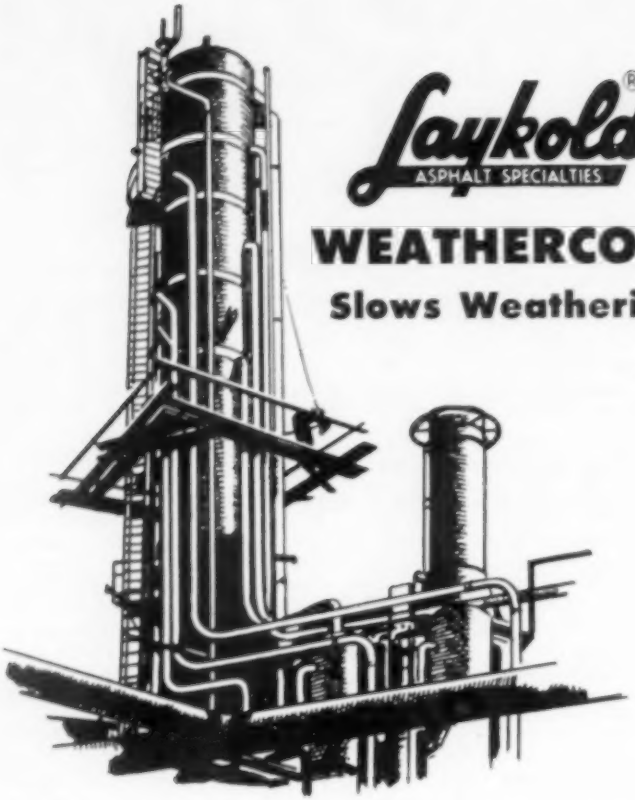
Research into the use of atomic energy in chemical processing operations will take place in a radiation laboratory now being installed at Diamond Alkali Co.'s Painesville, Ohio, research center.

Dr. A. W. Meyer, director of exploratory research, stated the objective of the new unit as "to further the exploration of the intriguing possibilities presented by harnessing gamma rays for chemical application, particularly for research on such reactions as polymerization, oxidation and chlorination."

The principal radiation tool will be a 1000 Curie radioactive cobalt source, fabricated for the company by the AEC's Brookhaven National Laboratory. Tracer quantities of other radioactive elements also will be utilized.

Personnel Changes

Worthington Corp. — Hobart C. Ramsey, president, to chairman of the board, succeeding Howard Bruce, who has been elected chairman of the executive committee; Edwin J. Schwanhausser, executive vice-president and member of the board, to president; Walther H. Feldman, vice-president in charge of sales, to executive vice-president, succeeded by Thomas J. Kehane, who leaves his former post of general sales manager to William A. Meiter, formerly central sales manager; Mr. Meiter has been succeeded



Laykold®
ASPHALT SPECIALTIES

WEATHERCOAT
Slows Weathering

WEATHER and WATER can't affect the protective qualities of Weathercoat: this tough ductile asphaltic coating *bridges* expansion, but remains firm under heat or cold.

That's why Weathercoat is preferred by most of the world's largest refineries* for protection of exposed insulation on fractionating columns, crude stills and tanks . . . for sealing insulation joints . . . exposed insulated pipelines . . . for membranes in reservoirs.

No fire hazard—apply it cold!
Brush, trowel or spray Weathercoat —it's easy—"palms" beautifully over uneven surfaces!

*Name on Request

AMERICAN
Bitumuls & Asphalt
COMPANY

200 BUSH ST. • SAN FRANCISCO 4, CALIFORNIA

E. Providence 14, R. I. Perth Amboy, N. J. Baltimore 3, Md. Mobile, Ala. Columbus 15, Ohio
Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La. St. Louis 17, Mo. Inglewood, Calif.
Oakland 1, Calif. Portland 7, Ore. Washington 6, D. C. San Juan 23, P. R.

by Clarence S. Wentworth, who was manager of the Detroit district office.

Swartwout Co.—Howard L. Joseph to southern California district manager of the power plant equipment and Autronic process controls divisions; A. Ray Wagner to southwest district resident sales and service engineer, with headquarters at the company's Houston office.

U.S. Steel Corp.—Ralph W. Seely, from vice-president and general manager, Consolidated Western Steel Division, to vice-president of sales, Columbia-Geneva Steel Division; R. E. Williams to the division's assistant vice-president of sales; Charles W. Lee succeeds Mr. Seely at Consolidated; Kenneth Lieber, formerly assistant vice-president and manager of Consolidated's pipe line sales, has been named vice-president of engineering. Mr. Seely is located in San Francisco; Mr. Lee and Mr. Lieber are at Maywood, Calif.

Oil Well Supply Division—M. F. Hazel to vice-president of sales; Alex Quayle, formerly chief engineer, succeeds Mr. Hazel as director of engineering; Lloyd E. Tracy, vice-president of sales, to vice-president of merchandise; Dan H. Barr, general merchandise manager to assistant to vice-president of sales; Ralph W. Rager, formerly administrative vice-president, to assistant to the manufacturing vice-president.

Harbison-Walker Refractories Co.—Frank Weir to assistant general sales manager.

Davison Chemical Co.—Charles E. Meginnis to district sales manager, industrial chemicals department, with headquarters in Chicago.

Diamond Power Specialty Corp.—Willis I. McCord, formerly with DuMont Laboratories, to manager of electronic sales.

Norton Co.—William H. Winemiller to assistant sales manager of the refractories division, replacing Kenric H. Bird, who retired after 27 years with the company.

Bechtel Corp.—John R. Kiely, vice-president, to the board of directors.

Liston-Becker Instrument Co. — Cedric Beebe to the staff of the application engineering group, from head of the physical analytical laboratory of the Koppers Co.

(To obtain more data on advertised products see page 264)

St. Louis Program for API Refiners

THE program has been set tentatively for the 20th Mid-Year meeting of the American Petroleum Institute's Division of Refining in St. Louis, at the Hotel Jefferson, May 9-12.

Subjects to be covered include analytical research, corrosion, training, smoke and fumes, product control, pressure vessels, processes, fuels and lubricants, maintenance, and products.

A total of 48 papers and one panel discussion on 10 subjects comprise the four-day program. The panel discussion will be on product control, Tuesday afternoon, May 10. Details on sessions at which papers will be presented are: (not including two sessions on analytical research, Monday, May 9, titles of which will be reported in PETROLEUM PROCESSING, next month.)

Monday, May 9, Morning

CORROSION

"The Use of Neutralizers and Inhibitors to Combat Corrosion in Hydrocarbon Streams," R. J. Hafsten and K. R. Walston, Standard Oil Co. (Indiana)

"Deterrence of Hydrogen Blistering at a Fluid Catalytic Cracking Unit," B. W. Neumaier and C. M. Schillmoller, Richfield Oil Corp.

"Cooling Water Treatment for Corrosion Control Pays Off," J. W. Dilliplane, J. J. Hur, and D. W. Wrigley, Atlantic Refining Co.

"A Study of the Deterioration of Large Concrete Sewers," (author to be named later), Esso Standard Oil Co.

Monday, May 9, Afternoon

TRAINING

"The Place of Effective Communications in Employee Development," M. E. Stone, Sinclair Oil Corp.

"A Procedure for Training Process Unit Operating Personnel," O. C. Day, Esso Standard Oil Co.

"Organization Planning in Relation to Management Development," Lounsbury Fish, Standard Vacuum Co., Inc.

Tuesday, May 10, Morning

SMOKE AND FUMES

"The Formation of Ozone in Polluted Atmospheres," L. M. Richards and M. D. Thomas, Stanford Research Institute.

"The Concentration of Ozone in Representative American Cities," J. Cholak, L. J. Schafer, and D. Yeager, The Kettering Laboratory, University of Cincinnati.

"Reactions Involving Ozone, Nitrogen Dioxide and Organic Compounds at low Concentrations in Air," Philip L. Hanst, Edgar R. Stephens, and William E. Scott, The Franklin Institute.

Tuesday, May 10, Evening

PRESSURE VESSELS

"Considerations Affecting More Economic but Equally Safe Pressure Vessel Construction Utilizing Either Present-Day Ductile Materials or New High Strength Less Ductile Materials," J. J. Murphy, C. R. Soderberg, Jr., and D. B. Rossheim, The M. W. Kellogg Co.

"Mechanical Properties and Weldability of Six High Strength Steels Applicable to Pressure Vessels," R. D. Stout and J. H. Gross, Lehigh University.

Wednesday, May 11, Morning

PROCESSES

"Hydrogen—Its Markets and Potential Uses," Robert L. James, A. D. Little, Inc.

"Hydrogen Recovery from Catalytic Reformer Off-Gases," Carl Pfeiffer and Henry J. Sandler, Catalytic Construction Co.

"Upgrading Distillate Fuels by Hydrofining," W. J. Zimmerschied, R. A. Hunt, Jr., and W. A. Wilson, Standard Oil Co. (Indiana)

"The Gulf HDS Process for Upgrading Crudes and Residues," Jerry McAfee, C. W. Montgomery, Joel H. Hirsh, and W. A. Horne, Gulf Research and Development Co., and C. R. Summers, Jr., Gulf Oil Corp.

FUELS AND LUBRICANTS

"Ignition of Fuels in a Constant Volume Bomb," R. W. Hurn, U. S. Bureau of Mines, Bartlesville, Okla.; M. A. Elliott, Illinois Institute of Technology, Chicago, Ill.; and H. M. Trimble, Phillips Petroleum Co., Bartlesville, Okla.

"Report on the 1953-54 Surveys on Vapor Lock and Hot Stalling and Starting Difficulties," Coordinating Fuel and Equipment Research Committee, Coordinating Research Council, Inc.

"Incentives for Precise Test Methods: The Case for a New Basic Knock Test Unit," M. R. Morrow, Humble Oil and Refining Co.

Wednesday, May 11, Afternoon

PROCESSES

"Hydrogen Recovery and Purification from Refinery Off Gases," J. T. Hugill and F. G. Kerry, Spaco, Inc.

"Hydropretreatment of Catalytic Reformer Feed," D. H. Stevenson and G. A. Mills, Houdry Process Corp.

"Unifining—A Proven Refining Technique," Davis Read and M. J. Sterba, Universal Oil Products Co., and F. L. Hartley and G. H. Hemmen, Union Oil Co. of California.

"Vapor Phase Hydrodesulphurization Applied to Cracked Naphthas and Light Straight-Run Intermediates," G. E. Liedholm, D. H. Sarno, and M. D. Abbott, Shell Development Co.

"Hydrofining and Fluid Coking for Processing High Sulfur Heavy Crude in a Low Sulfur Refinery," Standard Oil Development Co.

Thursday, May 12, Morning

REFINERY MAINTENANCE

"Planning and Building the Refinery for Minimum Maintenance," R. E. Redfield, Socony-Vacuum Oil Co., Inc.

"Prepared Discussion: Thermal Cycling Tests of a Hot Spot on a Vessel," P. N. Randall and H. A. Lang, Standard Oil Co. (Indiana).

"Scheduling Refinery Maintenance," Gulf Oil Corp.

"Use of Contractors' Maintenance Crews for Handling Large-Scale Refinery Turnarounds," J. W. Towler, Union Oil Co. of California.

Thursday, May 12, Afternoon

PETROLEUM PRODUCTS

"Protective Labelling of Petroleum Products," L. C. Beard, Jr., and A. C. Pabst, Socony-Vacuum Oil Co., Inc.

"Changing Distribution Pattern of Refinery Products."

"The Significance of Test Methods and Specifications on Product Control."

"Vapor Pressure-Temperature Correlations for Petroleum Hydrocarbons," Standard Oil Development Co.

SNT to Offer Program at Ninth Metal Congress

Twenty-four technical societies are cooperating with the American Society for Metals in sponsoring the Ninth Western Metal Congress and Exposition in Los Angeles from March 28 to April 1. The Congress will be held in the Ambassador Hotel and the exposition in the Pan Pacific Auditorium.

The Society for Nondestructive Testing, one of the sponsoring groups, has organized its activities during the five days around the idea of "Economic Progress Through Nondestructive Testing." The program will include papers on industrial applications of general nondestructive test methods such as eddy current instruments, conductivity measurements, evaluation of precision bearings by magnetic means, high-speed motion picture photography, leak detectors, determination of material thickness and experimental stress analysis.

Other general topics to be treated by the society are radiography, ultrasonics, magnetic particles and penetrant inspection methods.

WPRA Opens Series of Regional Meetings

The first of five regional technical-industrial relations meetings to be sponsored by the Western Petroleum Refiners Association during 1955 will be held in Beaumont, Texas, February 10 and 11. The meeting will use the Hotel Beaumont as headquarters.

Thursday, February 10, will be devoted to various aspects of industrial relations, featuring at least four papers on the subject. The technical session is scheduled for Friday.

Future regional technical-industrial relations meetings are:

May 26-27, Settles Hotel, Big Spring, Texas.

June 23-24, Broadview Hotel, Wichita, Kansas.

September 22-23, Hotel Henning,

(Advertisement)

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000

Pays Out In Under A Week

For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment—but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15,000—less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function—and they are doing it in more and more refining vessels every day. They remove liquid entrainment—efficiently and economically—wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions. Metal Textile Corporation, Roselle, New Jersey.

Casper, Wyo.

October 20-21, Garret Hotel, El Dorado, Ark.

ACS and AIChE Join to Give Technical Meeting at Lamar

The Second Annual Technical Meeting at Lamar State College of Technology, Beaumont, Texas, will be held on March 4. This event is sponsored by the college, the Texas-Louisiana Gulf Section of the American Chemical Society, and the Sabine-Neches Chapter of the American Institute of Chemical Engineers.

Two technical sessions will run concurrently in the morning, and the afternoon will be taken up with a forum of general interest. A mixer and banquet, featuring a well-known speaker, will conclude the evening.

Oil Man's Calendar

FEBRUARY

Western Petroleum Refiners Assn., regional technical-industrial relations meetings, Hotle Beaumont, Beaumont, Texas, February 10-11.

Natural Gasoline Assn. of America, Permian Basin regional meeting, Scharbauer Hotel, Midland, Texas, February 25.

MARCH

Corrosion Conference, sponsored by the National Association of Corrosion Engineers and the University of Tennessee, at the university, Knoxville, March 1-4.

Second Annual Technical Meeting, sponsored by Lamar State College of Technology, Beaumont, Texas, the Texas-Louisiana Gulf Section of the American Chemical Society and the Sabine-Neches Chapter of the American Institute of Chemical Engineers, at the college, March 4.

Chemical Institute of Canada, 5th divisional conference of the Chemical Engineering Division, Ottawa, Ont., March 7-9.

National Association of Corrosion Engineers, 11th annual conference and exhibition, Palmer House, Chicago, March 7-11.

Western Petroleum Refiners Assn., 43rd annual meeting, Plaza Hotel, San Antonio, Texas, March 28-30.

Ninth Western Metal Congress and Exposition, American Society for Metals and others, Ambassador Hotel and Pan Pacific Auditorium, Los Angeles, March 28-April 1.

APRIL

American Society of Lubrication Engineers, 10th annual meeting and lubrication exhibit, Hotel Sherman, Chicago, April 13-15.

National Petroleum Assn., 52nd semiannual meeting, Cleveland Hotel, Cleveland, April 13-15.

Natural Gasoline Assn. of America, annual convention, Baker and Adolphus Hotels, Dallas, Texas, April 13-15.

Third National Air Pollution Symposium, sponsored by the Stanford Research Institute and others, Huntington-Sheraton Hotel, Pasadena, Calif., April 18 and 19.

MAY

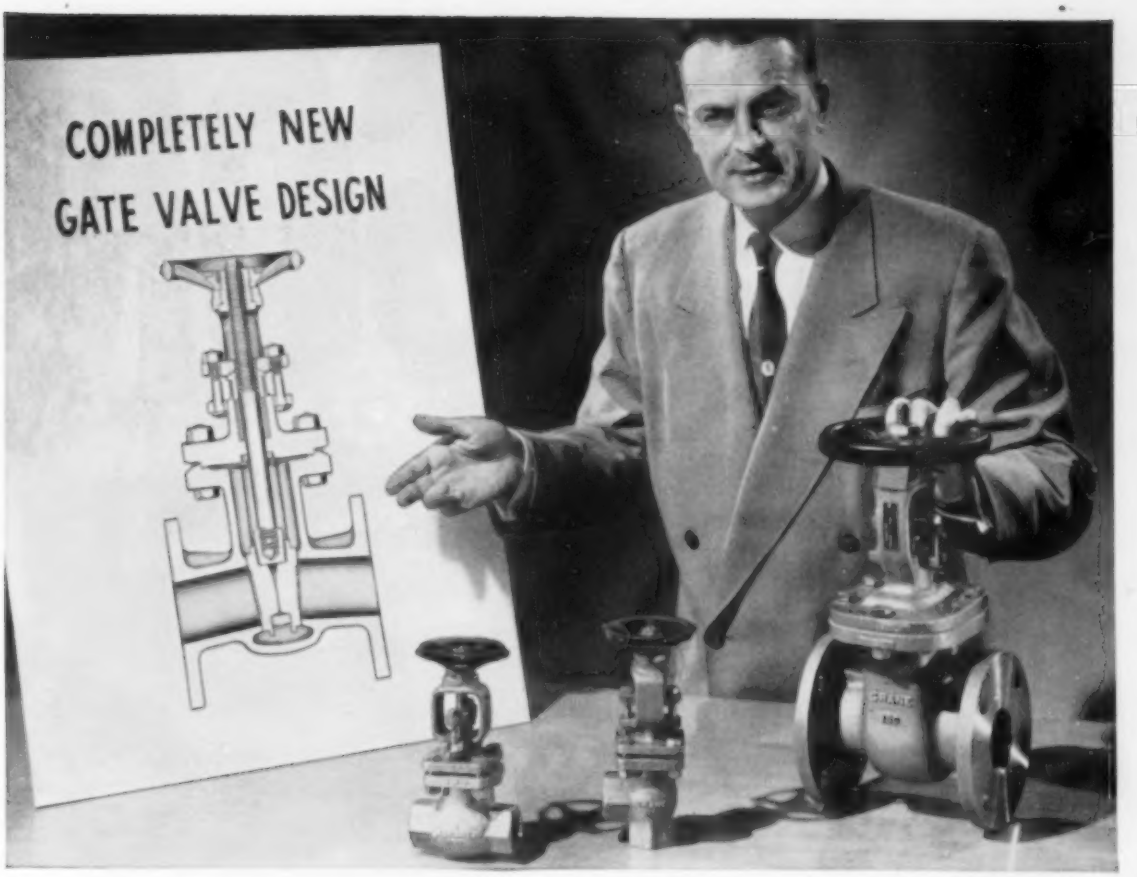
American Institute of Chemical Engineers, national meeting, Shamrock Hotel, Houston, Texas, May 1-4.

American Petroleum Institute, Division of Refining, midyear meeting, Jefferson Hotel, St. Louis, Mo., May 9-12.

JUNE

Fourth World Petroleum Congress, Rome, Italy, June 6-15.

Society of Automotive Engineers, golden anniversary summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 12-17.



New CRANE Corrosion-Resistant Valves in 18-8 SMo and Craneloy 20

Gate, Globe and Angle Patterns

Few valves for process industries have ever received the quality treatment given this new Crane line.

Note, for instance, the unique yet simple split-wedge disc construction in the gate valves. Those dual identical discs are free to rotate in their holder—the most effective design for resisting galling. The trunnion shape at the back of each disc assures even distribution of closing forces. You couldn't buckle them if you tried.

The globe and angle valves give equally outstanding control of corrosive fluids. A new type disc-stem connection, with minimum clearances, practically eliminates vibration. By placing seating load closer to seats, it provides easier, more accurate closure.

Throughout, these valves are built for better service in your choice of Crane 18-8 SMo Stainless Steel or Craneloy 20. Both lines come with screwed or flanged ends. Full information given in circular AD 2059—available from your Crane Representative or on request to address below.

New split-wedge disc in gate valves combines the benefits of free rotation with uniform seat load pressure.

CRANE CO.

General Offices: 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

DAVISON M-S® Catalyst

The Petroleum Industry's MOST WIDELY USED CATALYST!

- Narrow range of particle size distribution
- Low impurities
- Outstanding physical and catalytic characteristics
- Excellent attrition resistance

These are some of the reasons why Davison's Catalysts are the most widely used synthetic cracking catalysts in the petroleum industry. Throughout the world, Davison's catalysts crack more gas oil than any other catalyst.

Write today for a folder giving all the facts on Davison's M-S Catalysts . . . particle size distribution, chemical, physical and catalytic properties, etc.

Progress Through Chemistry

DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

Baltimore 3, Maryland

Sales Offices: New York, N. Y.; Chicago, Ill.; Houston, Texas

Producers of: Catalysts, Inorganic Acids, Superphosphates, Triple Superphosphates, Phosphate Rock, Silica Gels and Silicofluorides. Sole Producers of DAVCO® Granulated Fertilizers.

 (To obtain more data on advertised products see page 264)

IPAA Oil Industry Survey Out in 1954 Edition

A STATISTICAL reference book of oil and gas production in the 27 states productive of these minerals, the 1954 edition of "The Oil Producing Industry in Your State" brings output and a variety of other figures up to date through the year 1953. The volume is published by the Independent Petroleum Association of America.

An introduction describes the expansion in petroleum production over the past 25 years and the appreciation in value of crude oil, natural gas, and natural gas liquids. Annual production of these minerals, in fact, exceeds in value the yearly production of all other minerals and metals in the United States.

The classified collection of statistics begins with a survey of oil and gas production in the U.S. as a whole. Then the states are taken in alphabetical order, with information listed under these headings: extent and economic value of the industry, production, exploration and development, reserves and a general section.

At the head of each chapter is an outline map of the state in which the oil and gas-producing counties are distinguished by color from the others. Under the first subject, the extent and economic value of the industry, a number of general facts are presented: total land area and total mineral-productive area, value of well product drawn out in 1953, average field price of crude oil in that year, relative importance of petroleum production in the state, and the number of employees engaged in the industry during 1953.

The section on production reviews the output in the state over the years, giving the quantity for 1953 and for the best year on record, total production since wells were first tapped, the number of producing wells, and other information.

Under exploration and development are statistics showing the drilling carried on during 1953—of oil wells, gas wells, dry holes, and service wells—total footage drilled in that year, average depth of the wells, deepest well up to that time, and the number of drilling rigs in use.

The discussion of reserves contains information about new oil fields and pays found in 1953, crude and natural gas liquid reserves discovered, proved reserves of both, and other topics.

State gasoline taxes in 1953 and the rate of such taxes per gallon, the number of automobiles, trucks and buses registered in the year, and the number and capacity of refineries in the state as of January 1, 1954, are among the data presented under the title of general information, the final division of each chapter.

Issue ASTM Standards For Gaseous Fuels

ASTM Standards on Gaseous Fuels, February, 1954, 6x9 in., 178 pp., $2.50. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

ALL the methods for testing gaseous fuels approved by the American Society for Testing Materials are contained in the 1954 edition of this work, which was sponsored by the society's committee D-3 on gaseous fuels.

There are 12 standards described in the booklet. Five of the methods of testing, and one method of measuring, are new and thus tentative. These methods are: for sampling manufactured gas; sampling liquefied petroleum gases; measurement of gaseous fuel samples; analysis of carbureted water by the mass spectrometer; sulfur in petroleum products and liquefied petroleum gases by the CO_2-O_2 lamp method; and vapor pressure of liquefied petroleum gases.

Other test methods cover the following: sampling natural gas; analysis of natural gases by the volumetric-chemical method, and of natural gases and related types of gaseous mixtures by the mass spectrometer; and three methods for gaseous fuels—to find water vapor content by measurement of dew-point temperature, calorific value by the water-flow calorimeter, and specific gravity.

1948-49 Corrosion Survey Released by NACE

Bibliographic Survey of Corrosion, 1948-1949, published by the National Association of Corrosion Engineers, 8½x11 in., hard cloth binding, 346 pp., 1954. Available from National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2, Texas, at $10.00 to association members, $12.50 to non-members.

THIS volume completes a series of three works covering the literature on corrosion between 1945 and 1949. In this bibliography alone the editors were able to compile 3512 summaries from some 500 periodicals and books appearing during 1948 and 1949, supplementing their resources with the services of over 30 abstracting agencies.

The book employs a system of classification for the papers developed by a committee of the National Association of Corrosion Engineers. It divides the literature into eight main groupings: general, testing, characteristic corrosion phenomena, corrosive environment, preventive measures, materials of construction, equipment, and industries. Each group is appropriately subdivided and cross references are provided after each section to help locate related material that might be placed under a different heading.

An author and subject index are included in the appendix. The former contains more than 2700 names; companies and associations are omitted. The subject index lists a number of metals and alloys by trade name, supplying guides to places in the main body of abstracts where mention appears of their specific properties or behavior in specific media.

Another feature of the appendix is a page giving information about the procedure to be followed in obtaining photostat copies of material printed in unfamiliar foreign or domestic journals.

New Basic Work Covers Gas and Liquid Theory

Molecular Theory of Gases and Liquids, Joseph O. Hirschfelder, Charles F. Curtiss, and R. Byron Bird; 6x9 in., xxvi +1219 pp., stiff cloth binding, 1954, $20. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.

THE authors of this volume had the objective of presenting a treatment of the entire field of gas and liquid theory from a unified viewpoint and with a consistent notation. The viewpoint is a "molecular" one, which means that expressions for gas and liquid properties can be cast in terms of molecular properties and intermolecular forces. These expressions are derived from statistical mechanics, and when coupled with information about intermolecular interactions can be used to predict the values of many physical properties for which no experimental data are available.

The authors have divided properties into two groups: 1) equilibrium properties, such as the equation of state, Joule-Thomson coefficient, and surface tension; and 2) non-equilibrium properties, of which viscosity, diffusion and thermal conductivity are examples. The organization of the book follows this theoretical distinction, so that there are three major parts, one each devoted to equilibrium and non-equilibrium properties, and a third section given to intermolecular forces.

Chapter 1 presents a discussion of the basic problems associated with each of the fields and serves as an introduction to the rest of the book.

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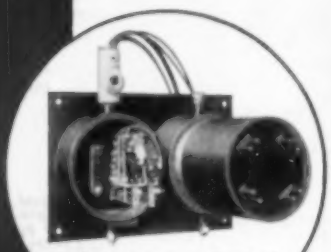

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Part I begins with chapter 2, continuing through chapter 6, and consists of a survey of equilibrium statistical mechanics, which is used as the basis of the theoretical development of the equation of state. Two applications of the theory are then given—the prediction of the p-V-T properties of gases and liquids, and the analysis of experimental equation of state data to obtain information about intermolecular forces.

Chapters 7 through 11, which make up Part II, contain a discussion of non-equilibrium statistical mechanics (kinetic theory) and the theory of transport phenomena. This section generally follows the organization of the first part; that is, the prediction of the bulk properties, and the methods of obtaining information about intermolecular forces are considered. Part II concludes with a chapter on hydrodynamic applications, which contains a unified discussion of the propagation of sound waves, flames and detonations.

Part III (Chapters 12-14) deals with the electromagnetic and quantum mechanical theory of the forces between molecules, atoms, ions, and free radicals. In it *a priori* quantum mechanical calculations of intermolecular forces are compared with the information obtained in the first two parts by the analysis of the experimental data on bulk properties.

The book may be fairly described as highly technical, not in the least a simplified treatment, and useful primarily to students and theoretical workers. This should be qualified to include experimental physical chemists and industrial engineers, who, the authors anticipate, may be aided in their design work by the chapters on calculations of the properties of gases and liquids. For this purpose extensive tables have been included, and numerical examples given to illustrate their use.

Recent Books Briefly Noted

Testing of Hydrometers, by J. C. Hughes, National Bureau of Standards Circular 555, 1954, 10 pp., paper cover, $0.10, Government Printing Office, Washington 25, D.C.

. . . supersedes NBS Circular 477, and discusses design, construction, and calibration of hydrometers and specifies the Bureau's certification requirements and how to present them to the Bureau for certification.

Report of the Thirty-Ninth National Conference on Weights and Measures, National Bureau of Standards Miscellaneous Publication 212, 1954, 108 pp., paper cover, $0.50, Government Printing Office, Washington 25, D.C.

. . . contains addresses and reports

delivered in May, 1954, on topics such as check weighing scales, electromagnetic flowmeter, legislation, committees on specifications and tolerances reports, fabric measuring devices and others.

Fisher/Tag Manual for Inspectors of Petroleum, 28th ed., 1954, 9¼ x 6 in., 220 pp., indexed, illustrated, stiff cloth cover, $1.75, Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

. . . for oil chemists, gives details for 35 widely used tests for basic physical and chemical properties of petroleum and its products, such as gravity, color, viscosity, distillation range, vapor pressure, gum content, sulfur, carbon residue and others.

Process Control by A. J. Young, 1954, 8¼ x 5¼ in., 132 pp., indexed, illustrated, stiff cloth cover, $2.00, Instruments Publishing Co., Pittsburgh 12, Pa.

. . . for the technical man not specialized in instruments, discusses the basics of control systems, modes, and equipment. The author is Head of the Central Instrument Section of Imperial Chemical Industries, Ltd., Great Britain.

ASTM Standards on Adhesives (with Related Information), sponsored by ASTM Committee D-14 on Adhesives, 1954, 9 x 6 in., 216 pp., indexed, illustrated, heavy paper cover, $1.75, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . brings together all ASTM test methods, definitions, specifications and recommended practices pertaining to adhesives, including rubber cements, brake shoe adhesives and vulcanized rubber, electrical insulation and other miscellaneous items.

Symposium on Diesel Fuels, presented at meeting of Committee D-2 on Petroleum Products nd Luricants, Philadelphia, Pa., Feb. 17, 1954, 6 x 9 in., 56 pp., table of contents, illustrated, heavy paper cover, $1.50, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . nine symposium papers covering diesel fuel availability and demand outlook, furnace oils used for diesel fuels, distribution and storage, filling station supplies, diesel fuels in contracting, coach, railroad, and marine equipment, and a review of fuel specification requirements.

Fundamentals of Friction & Lubrication in Engineering, 1st ASLE National Symposium, 1954, 8½ x 5½ in., 196 pp., table of contents, illustrated, heavy paper cover, $3.50 ($3.00 to members), American Society of Lubrication Engineers, 84 E. Randolph St., Chicago 1, Ill.

. . . twelve symposium papers cover concepts and application of hydrodynamic and film lubrication, lubrication of bearings, gear teeth, slide contacts, and fundamental theories involved.

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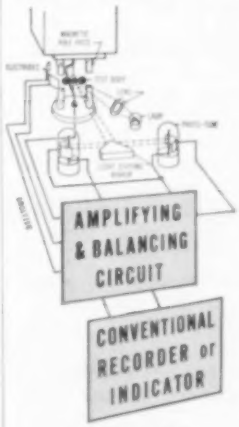

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Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ADDITIVE, fuel oil, FOA-2, samples and booklet; DuPont Co. See adv't. p. 240.

BLENDERS, automatic, multiple component, bulletin SM-2060 and other data available; Proportioneers, Inc. See adv't. cover 2.

CATALYST, synthetic, descriptive folder; Davison Chemical Co. See adv't. p. 258.

CATALYST ACTIVITY testing unit, for commercial and research uses, bulletins 6972 & 2531; Laboratory Equipment Corp. See adv't. p. 144.

CONDENSING SECTIONS, cast iron, bulletin CEC-54; National Radiator Co. See adv't. p. 250.

COOLING TOWERS, "Wind-Trol," descriptive literature; Santa Fe Tank & Tower Co., Inc. See adv't. cover 4.

CYLINDERS, stainless steel, for pressure sampling, information available; Hoke, Inc. See adv't. p. 288.

DRYING EQUIPMENT, air and gas, dessicant type, booklet; Pittsburgh Lectrodryer Corp. See adv't. p. 275.

ENTRAINMENT SEPARATORS, wire-mesh type, case studies and booklet available; Otto H. York Co., Inc. See adv't. p. 169.

FLOATING ROOFS, double pontoon, manual WP-14; General American Transportation Corp. See adv't. p. 142.

FLOOR MAINTENANCE, polishers and scrubbers, explosion-proof, information; Lincoln-Schlueter Floor Mach. Co. See adv't. p. 244.

GAGES, lined, corrosion-resistant, drawing GD-431; Jerguson Gage & Valve Co. See adv't. p. 238.

GASKETS, and accessories for glass piping, "Teflon," catalog TG-953; U. S. Gasket Co. See adv't. p. 270.

JACKETING, aluminum, for pipe, data available; Childers Mfg. Co. See adv't. p. 172.

JOINTS, flexible, shock and strain relief, information and drawings available; Barco Mfg. Co. See adv't. p. 290.

LEAD PRODUCTS, for corrosion resistant service, detailed booklet, National Lead Co. See adv't. p. 165.

LIQUID DENSITY, measurement and control, "Densitrol," bulletin W-3; Precision Thermometer & Instrument Co. See adv't. p. 277.

MASS SPECTROMETER, two types, bulletin CEC-1824A-X13; Consolidated Engineering Corp. See adv't. p. 155.

MATERIALS HANDLING, truck and container system, details on request; Dempster Brothers, Inc. See adv't. pp. 166-167.

MIXERS, side and top entering, nine catalogs; Mixing Equipment Co. See adv't. p. 188.

MOTOR STARTERS, for hazardous locations, booklet 1062; Electric Controller & Mfg. Co. See adv't. p. 260.

OXYGEN ANALYZERS, continuous measurement of process streams, literature on request; A. O. Beckman, Inc. See adv't. p. 261.

PRESSURE TRANSMITTER, shiftable range, bulletin 98097; Taylor Instrument Cos. See adv't. pp. 178-179.

PUMP PACKINGS, metallic and semi-metallic, file DMPP; Durametallic Corp. See adv't. p. 286.

PUMPS, for liquids, gases and slurries, catalog; Sigmamotor, Inc. See adv't. p. 256.

PUMPS, proportioning, for small volume flows, catalog UP-52R; Hills-McCanna Co. See adv't. p. 293.

PUMPS, vertical, centrifugal, bulletin 100-A; Pacific Pumps, Inc. See adv't. p. 248.

REFRACTORY GRAIN, several types, new booklet, "Norton Refractory Grain;" Norton Co. See adv't. p. 170.

REFRACTORY LININGS, several types, literature available; Bigelow-Liptak Corp. See adv't. p. 180.

REFORMING, catalytic, "Houdriforming," brochure; Houdry Process Corp. See adv't. p. 252.

STEAM TRAPS, high capacity, many styles and sizes, catalog available; Armstrong Machine Works. See adv't. p 160.

STEAM TRAPS, six types available, catalog 953; W. H. Nicholson & Co. See adv't. p. 150.

TEMPERATURE RECORDING equipment, three standard types, catalog; Electric Auto-Lite Co. See adv't. p. 286.

TUBE CLEANER, air motor driven, for condensers, information on request; The Airetool Mfg. Co. See adv't. p. 289.

TUBING, many styles fabricated from many metals, chart and booklet; Wolverine Tube. See adv't. pp. 248A-248B.

TURBINES, vertical and horizontal, catalog 500; Dean Hill Pump Co. See adv't. p. 168.

VALVES, gate, corrosion-resistant, circular AD-2059; Crane Co. See adv't. p. 257.

VALVES, lubricated plug, catalog reference book 39; Homestead Valve Mfg. Co. See adv't. p. 273.

VISCOSITY MEASUREMENT, several models, booklet; Brookfield Engineering Labs. Inc. See adv't. p. 278.

WRENCH, chain type, several sizes, literature available; Reed Mfg. Co. See adv't. p. 288.

Line-up of eight Cooper-Bessemer 8- and 10-cylinder compressors at Ballinger, Texas. Two GMV-8-TF's are used for propane refrigeration, and injection, while the remaining six compressors are used for plant process gas.

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ADVERTISERS' INDEX

This index is published as a convenience to the reader. Every care is taken to make it accurate, but PETROLEUM PROCESSING assumes no responsibility for errors or omissions.

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum processing Reader Service Department will give your inquiries prompt and efficient handling.

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A4	B4	C4	D4	E4	F4	G4	H4	I4	J4	K4	L4	M4	N4	O4	P4
A5	B5	C5	D5	E5	F5	G5	H5	I5	J5	K5	L5	M5	N5	O5	P5
A6	B6	C6	D6	E6	F6	G6	H6	I6	J6	K6	L6	M6	N6	O6	P6
A7	B7	C7	D7	E7	F7	G7	H7	I7	J7	K7	L7	M7	N7	O7	P7
A8	B8	C8	D8	E8	F8	G8	H8	I8	J8	K8	L8	M8	N8	O8	P8
A9	B9	C9	D9	E9	F9	G9	H9	I9	J9	K9	L9	M9	N9	O9	P9

PETROLEUM PROCESSING
A McGRAW-HILL PUBLICATION

2/55

Name (Please Print) _____ Position _____

Company _____ Business Address _____

City, Zone _____ State _____

PETROLEUM PROCESSING READER SERVICE INFORMATION CARD—VOID AFTER MAY 15, 1955

"WHAT'S NEW" ITEMS

1	2	3	4	5	6	7	8
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ADVERTISED PRODUCTS

A1	B1	C1	D1	E1	F1	G1	H1	I1	J1	K1	L1	M1	N1	O1	P1
A2	B2	C2	D2	E2	F2	G2	H2	I2	J2	K2	L2	M2	N2	O2	P2
A3	B3	C3	D3	E3	F3	G3	H3	I3	J3	K3	L3	M3	N3	O3	P3
A4	B4	C4	D4	E4	F4	G4	H4	I4	J4	K4	L4	M4	N4	O4	P4
A5	B5	C5	D5	E5	F5	G5	H5	I5	J5	K5	L5	M5	N5	O5	P5
A6	B6	C6	D6	E6	F6	G6	H6	I6	J6	K6	L6	M6	N6	O6	P6
A7	B7	C7	D7	E7	F7	G7	H7	I7	J7	K7	L7	M7	N7	O7	P7
A8	B8	C8	D8	E8	F8	G8	H8	I8	J8	K8	L8	M8	N8	O8	P8
A9	B9	C9	D9	E9	F9	G9	H9	I9	J9	K9	L9	M9	N9	O9	P9

PETROLEUM PROCESSING
A McGRAW-HILL PUBLICATION

2/55

Name (Please Print) _____ Position _____

Company _____ Business Address _____

City, Zone _____ State _____

FOR MORE INFORMATION...

about products and services advertised in this issue of Petroleum Processing or reviewed in its "What's New" section, use the postage-free cards provided below.
(See other side for complete instructions.)

FIRST CLASS
PERMIT NO. 64
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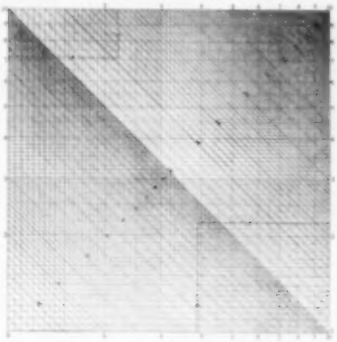
PETROLEUM PROCESSING

330 WEST 42nd STREET

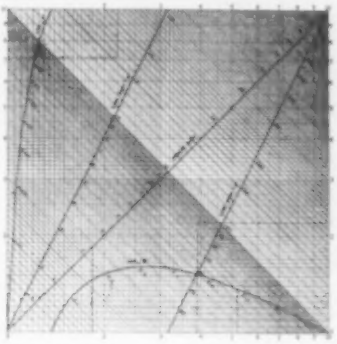
NEW YORK 36, N. Y.

WHAT'S NEW...

MULTIPLICATION AND DIVISION CHART



MULTIPHASE MATHEMATICAL CHART



Graphical Slide Rule Fits in Pocket

Two new mathematical charts developed by E. J. George, Sun Oil Co. engineer can be used for the same purpose as a slide rule or calculating machine. The charts consist of a log scale superimposed diagonally upon a log-log grid. The "Multiphase Mathematical Chart" has scales for multiplication, division, square root, cube root, and logarithm of a number. The "Multiplication and Division Chart" is similar without the log, square and cube root curves. Both charts contain illustrative examples to aid in their use. Accuracy is the same as that of a 7½ in. slide rule, and the charts may be used without a straight edge. Test runs have shown chart calculations to be fifty percent faster than those made with a slide rule and twice as rapid as a calculating machine. Initially these charts were introduced to aid students in Mr. George's chemistry classes at Drexel Evening College, but since then have found use elsewhere. They may be carried in the back of a notebook, or placed under the glass on a desk top for use. E. J. George, 428 E. Magnolia Ave., Aldan, Delaware County, Pa.

Circle No. **1** *on Reply Card*

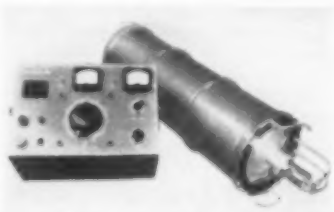
Micro Pipette Burette Makes Titrations Easier, Faster

. . . and is easy to fill and clean since the titrating fluid comes in contact with only glass and Teflon. Available in 10 ml. size, accuracy is insured by a precision ground glass plunger. A vacuum tight seal is provided by sealing the plunger in with a Teflon gasket, backed up with silicone rubber. Parts to convert the 0.1 or 1 ml. size of "Micro Pipet Burets" to the new 10 ml. size have also been developed. Emil Greiner Co., 20-26 N. Moore St., New York 13, N. Y.

Circle No. **2** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.



High Power X-Ray Unit Tests Pipelines, Tanks and Boilers

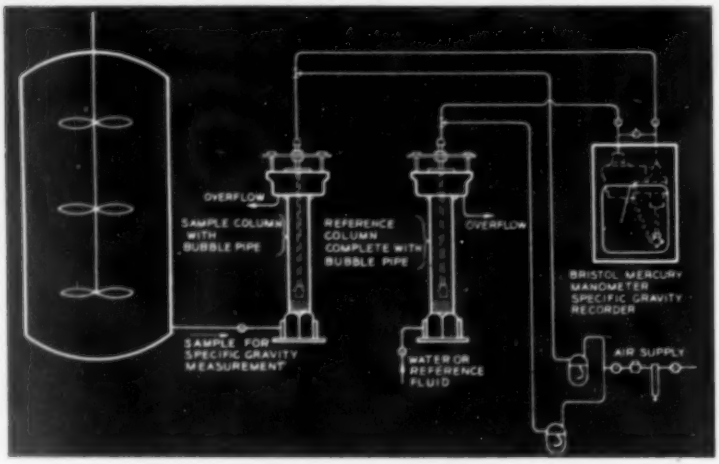
. . . and can be operated by relatively inexperienced personnel. The "X-Tron 180" is portable and can be transported in a car. The unit will penetrate 2-⅛ in. of steel and will traverse a pipe line greater than 12 in. diameter. All parts are American made and are easily replaced. It contains a specially designed transformer and X-ray tube and a high voltage generator that delivers 180 K.V. and 10 M.A. continuously. Special features include a compensating device for line fluctuation, special provision for cooling, and safe-guards against either thermal or electronic overloading. The control panel is semi-automatic. All controls are weatherproof. Mitchell Radiation Products Corp., 128 E. Washington St., Norristown, Pa.

Circle No. **3** *on Reply Card*

New Liquid Meters Have Ticket Printer for Inventory Control

. . . and to aid in quality control Called the "Print-O-Meter," it automatically stamps a ticket with the number of gallons or pounds of liquid ingredients delivered to a batch or process. It provides a permanent printed record, printing letters and serial numbers on the ticket to identify the operator and the batch. The ticket printer is an added feaure, completely recessed within the register of the Neptune Type S Industrial Liquid Meter, and is similar in design to printers which have been used on tank trucks delivering fuel oil to home owners. Operation is by inserting the ticket—with carbons as required—into a slot and locking in place by turning a knob on the side of the register which resets the visible wheels to zero before recording the new quantity delivered. Available with meters from 1 to 4 in., and flow rates from 5 to 500 gpm., it can also be combined with automatic shut-off switches. Neptune Meter Co., 19 W. 50th St., New York 20, N. Y.

Circle No. **4** *on Reply Card*

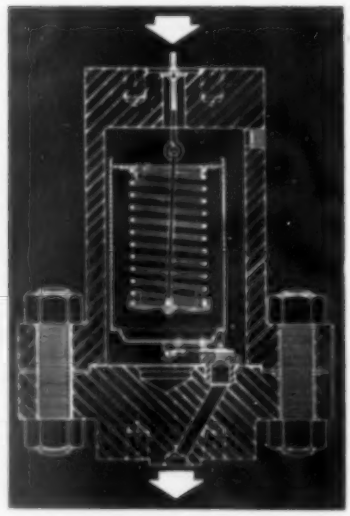


Specific Gravity by Reference Column

A new line of specific gravity meters suitable for liquid solutions, mixtures, and slurries operates by comparing the pressure necessary to displace a given head of the sample liquid in a bubbler pipe with the pressure necessary to displace an equivalent head of water. Instrument calibration can be directly in terms of specific gravity, Twaddell units, degrees Baume, etc.

The meters are factory calibrated for the liquid in question, and can be used for any liquid into which a bubbler pipe can be inserted. They use a mercury meter body, with or without counterpoise, and a standard Bristol Series 500 recorder which can be equipped to provide automatic control of the specific gravity in any of five control modes. The Bristol Co., Waterbury 20, Conn.

Circle No. **5** *on Reply Card*



New Trap Drains Water From Air or Gas at 3000 Psig

. . . in cases where no gas loss is permissible. Trap has a non-collapsible, spring-balanced open float which normally holds the valve closed by the weight of water in the bucket compressing the spring. Entering condensate fills the trap body adding buoyancy to the float which aided by the spring compression overcomes the weight of the water and bucket. As the bucket floats, it opens the valve allowing the condensate to discharge. The water sealed valve closes before all of the water is discharged, thus preventing the escape of gases. Capacity at 2000 psig is 2000 lb./hr. Working parts are stainless steel. Body and cap are ASTM F-5 chrome moly steel. Inlet connections are flanged 1 in. or 1¼ in. Outlet connections are flanged or screwed 1 in. or 1¼ in. Height is 15⅞ ± ¼ in., diameter at flanges is 2½ in. Armstrong Machine Works, Three Rivers, Mich.

Circle No. **6** *on Reply Card*

New Rubber Compound O-Rings Seal High Vacuum Equipment

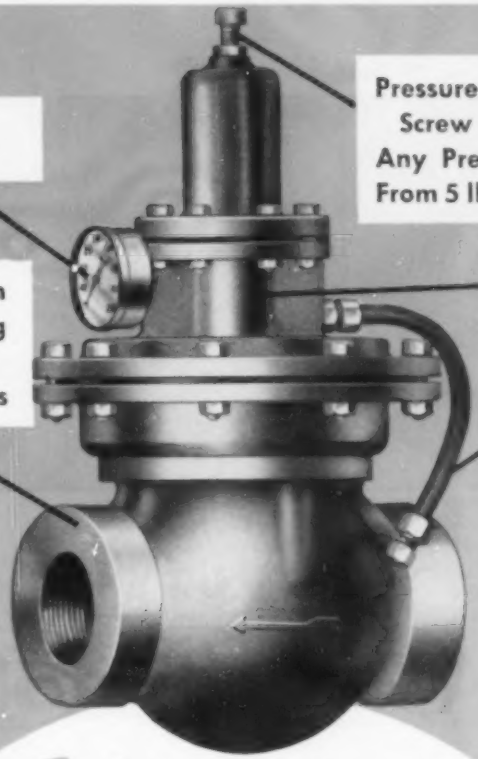
. . . for distillation, evaporation, and electronic devices. Designated "366YV," the compound is a special formulation of Buna N polymer which can be made into special shapes as well as standard sizes of quad-rings and O-rings. Chief advantages are high resistance to out-gassing at high temperatures and long service life in permanent installations. Free samples are available to equipment manufacturers and testing laboratories. Minnesota Rubber and Gasket Co., Dept. KP, 3630 Wooddale Ave., Minneapolis 16, Minn.

Circle No. **7** *on Reply Card*

Compact Temperature Monitor Uses Magnetic Circuitry

. . . and has no vacuum tubes or relays for stability, reliability and ruggedness. Designed for precise temperature measuring, indicating and warning for industrial, airborne, and laboratory use, it provides an instantaneous warning of circuit temperature changes above or below a predetermined level. An indicator lamp flashes on when the present maximum or minimum allowable temperature is reached, and remains on until the temperature returns to normal. The indicator panel meter can be switched to any channel for direct reading of channel temperature in percentage of critical temperature. The meter is calibrated with dial markings of from 50 to 120%. Arnoux Corp., Dept. PP-2, 1357 S. Hawthorne Blvd., Hawthorne, Calif.

Circle No. **8** *on Reply Card*



Pressure Gauge

Pressure Adjustment Screw To Control Any Pressure Range From 5 lbs. to 125 lbs.

Hi-Tensile Cast Iron Valve Body, Spring Housing And Diaphragm Casings

Integral Pilot Controller

Pressure Transmission Tube

Sizes—2" Screwed Globe
3" and 4" Flanged Globe

Control Range—
5 lbs. to 125 lbs.

Temperature Range—
Up to 165° F.

- Pilot Operating Mechanism Machined From Stainless Steel and Aluminum.
- Buna-N Valve Diaphragm With No Center Punching.
- Nylon Reinforced Buna-N Soft Seat Insert.
- Spring Loaded Teflon Packing.
- Stainless Steel Valve Stem.
- Valve Seat Machined Into Valve Body.

Introducing...

The New BS&B Type 73-22

BACK PRESSURE REGULATOR

...with *Integral Controller!*

Here is the ideal Back Pressure Regulator and valve for services where *close regulation* and *complete closure* are required in a single instrument. Its integral controller provides even closer sensitivity to pressure fluctuations than can be obtained with a weight loaded regulator—yet it has a much wider range of adjustment than is possible with a regulator that depends on direct spring loading.

Designed for optimum control on low pressure oil separators, water knockouts, gunbarrels, gas gathering lines and other equipment requiring close pressure control as well as tight shut-off, the BS&B Type 73-22 also works as well, within its pressure limitations, in all gas or air services that require back pressure regulation.

A feature of this regulator is its ability to operate with the dissipation of a *minimum* quantity of the gas or air used in the controller.

Type 73-22 meets 100% the high standards of *quality* and *performance* for which all BS&B Controls have become so famous throughout the industry. If you'd like more details, write to us direct . . . or ask your BS&B Controls Representative.

Controls Division, Dept. 4-D2
84 Sales Centers 40 Stocking Points

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.
7500 East 12th Street • Kansas City 26, Missouri

DOW

You Can See Why

SARAN LINED PIPE

CUTS CORROSION COSTS

Corrosion resistant Saran Pipe swaged into steel is your answer to downtime losses.

Saran lined pipe, fittings and valves are built to convey acids, alkalies and other corrosive liquids at low over-all costs. The durable inner lining eliminates shutdowns due to corrosion and forms snug, tight-fitting joints that prevent leakage.

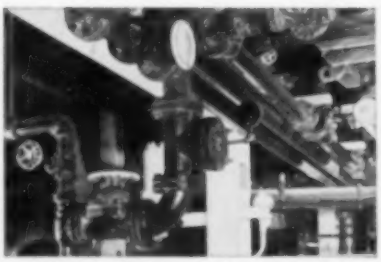
Saran lined pipes, fittings, and valves are easily and inexpensively installed. They are cut and threaded in the field with any standard pipe fitter's tools. Because of saran lined pipe's rigidity, even long spans require a minimum of support.

If your operation requires the conveying of corrosive liquids, and if downtime losses are troubling you, investigate saran lined pipe, fittings, and valves today. For further information, contact the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Mich. Dept. 526-F.

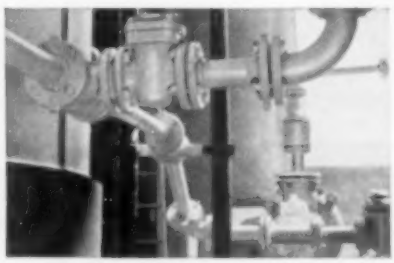
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY
INSTALLATIONS USING
SARAN LINED
STEEL PIPE

Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan



A large chemical company uses this installation to convey demineralized water. It has a perfect record of keeping the water free of contamination for five years!



Saran lined pipe used for conveying hydrochloric acid at temperatures from 20° to 90°C., has had no unscheduled interruptions due to corrosion for over two years!

you can depend on DOW PLASTICS DOW

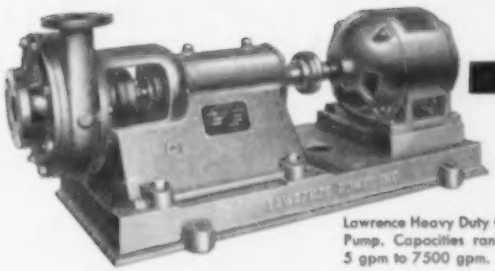
Thermostatic Pilot Controller May Be Used in any Position

. . . and can be employed in control systems where rapid response and adjustable control characteristics are required. The "Fultrol" pilot has its rod-and-tube sensing element directly immersed in the medium being controlled. It may be installed vertically, horizontally, or diagonally. Temperature changes at thermal element activate a small pilot valve, which in turn varies the control pressure applied to a motor valve or any other final control device. It is designed to control temperatures in wide adjustable ranges from 50° to 250° F. and from 150° to 350° F. Gages indicate both pilot supply pressure and control pressure. Robertshaw-Fulton Controls Co., Fulton Sylphon Div., Box 400, Knoxville 1, Tenn.

Circle No. 9 on Reply Card

Ultrasonic Emulsifier Makes Finely-Divided Emulsions

. . . of a permanent nature from two or more liquids which would otherwise be difficult or impossible to mix. Emulsifying action results from intense cavitation forces of focused ultrasonic waves which produce a state of fine division of one liquid into another. The division is in the lower-micron and sub-micron range, which helps to insure permanency and dilutability. Stabilizers which might alter the chemistry of the emulsion are either unnecessary or needed in much smaller quantities. The illustrated



Lawrence Heavy Duty Chemical Pump. Capacities range from 5 gpm to 7500 gpm.

HORIZONTAL

ACID and CHEMICAL PUMPS

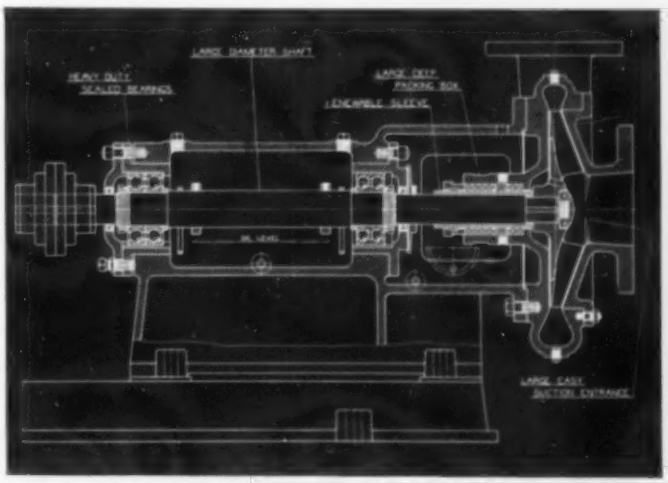
No class of service puts a more exacting duty upon pumps than the chemical and process industries. The problem is not simply the handling of a fluid, but of resisting the destructive action of the fluid itself.

In this difficult field Lawrence engineers have had repeated and successful experience with practically every "pumpable" fluid. The range of materials pumped includes all kinds of acids, caustics, dye solutions, bleach solutions, various oils, syrups, fruit and vegetable juices, pulps, and liquids carrying a high percentage of abrasive or solid matter in suspension.

The metals and alloys used in Lawrence acid and chemical pumps are carefully selected for their ability to resist the corrosive and abrasive action of the liquid pumped. Those most commonly used are: stainless steel, nickel, Monel, bronze, Hasteloy, Ni-resist, lead, aluminum, iron and steel.

If your problem involves pumping acids, chemicals or slurries write us the pertinent details. No obligation.

Write for Bulletin 203-6 for summary of acid and chemical pump data.



Cross-section of Lawrence Heavy Duty Chemical Pump.

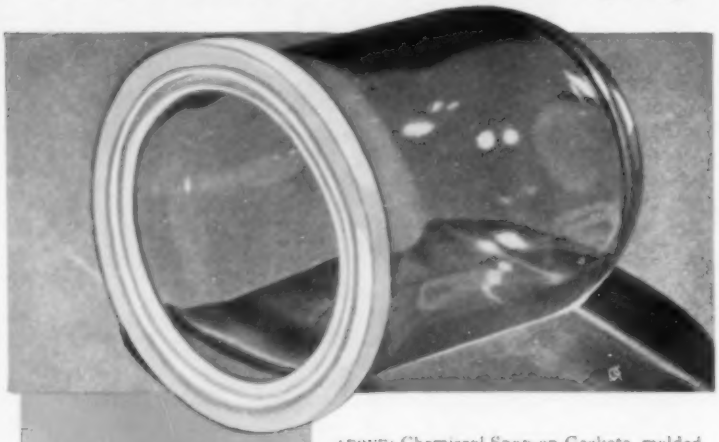
LAWRENCE PUMPS INC.

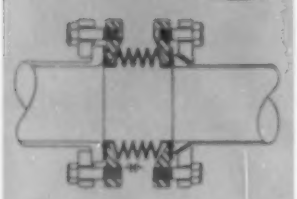
361 MARKET STREET, LAWRENCE, MASS.

Chemiseal Gaskets

MADE OF TEFLON

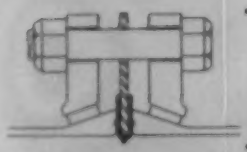
and Accessories for Glass Piping



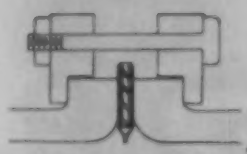


ABOVE: Chemiseal Snap-on Gaskets, molded of TEFLON to match contour of conical end glass pipe, assure perfect automatic centering of joints and free flow of materials. For all standard pipe sizes from ¼ in. to 6 in.

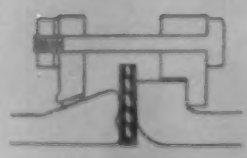
AT LEFT: Chemiseal Expansion Joints and Flexible Couplings absorb shock and vibration, thermal expansion and contraction. Correct misalignment. Connect unlike piping ends and nozzles.



Chemiseal TEFLON-Jacketed Gaskets, standard for Corning conical flanges. Seal at low bolt loads. Sizes from 1 in. to 6 in.



Chemiseal TEFLON-Jacketed Gaskets. Compressed asbestos sandwiched between woven asbestos inclosed in a TEFLON envelope. Ideal for glass-lined steel connections. Seal at low bolt loads.



Chemiseal Adaptors provide a safe, tight seal between unlike piping ends and nozzles. A steel bearing ring provides rigidity. Resilient core assures positive seal. TEFLON Jacket protects and contains easy-to-handle single unit.

WRITE FOR CATALOG NO. TG-953.

UNITED STATES GASKET COMPANY • CAMDEN 1, NEW JERSEY

USG

FABRICATORS OF FLUOROCARBONS & OTHER PLASTICS

Representatives in principal cities throughout the world

"Model EM 750" was designed to produce a pure emulsion of oleic acid in water at the rate of 4 gal./hr. using no stabilizer. McKenna Laboratories, 2503 Main St., Santa Monica, Calif.

Circle No. **19** *on Reply Card*

New Absorption Fractionator Analyzes Light Hydrocarbons

. . . including natural gas, gasoline plant gases and liquids, refinery gases, cycling plant gases, liquefied petroleum gases, synthetic rubber intermediates, petrochemical gases and others. The "Fracton" gives analyses two to three times faster than previous methods. A dry natural gas may be analyzed for light components in ¾ to 1 hr., a wet natural gas for heavy ends in 3 hr. The analysis of liquefied petroleum gas takes 1¼ to 1½ hr. and a refinery mixture containing unsaturates takes 1½ to 2½ hr. Control analyses may be made even more quickly. The instrument is a self contained unit-package containing no fragile connections, glass stopcocks, rubber connections or refrigerants. Operation is simple and largely automatic. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Circle No. **11** *on Reply Card*

New Chemical Nickel-Plating Is Uniform, Corrosion-Resistant

. . . for petroleum, petrochemical and chemical equipment processing corrosive or high-purity materials. The "Alcoplate" process is the catalytic reduction of nickel by sodium hypophosphite in solution at elevated temperatures to deposit a layer of 93% nickel and 7% phosphorus. The process' throwing power is 100% giving a plating uniformity of ±10% thickness on any metal surface, no matter how intricate, making it possible to protect surfaces which cannot be plated by cladding or electrolytically. In thin plating coats of less than one mil, zero porosity is obtained. Accelerated tests have proven Alcoplate's resistance to petroleum products, phenols, chlorinated solvents, water, caustics, alcohol, soaps, fats, and plastics, with excellent resistance to the higher fatty acids—such as oleic and stearic. Plating hardness is about 500 Vickers, or 48 Rockwell C, and through post-plate heat-treating, can be increased to 950 Vickers, or 66 Rockwell C. The Alcoplate process is an adaptation of the Kanigen process—first announced in 1953—on license from the General American Transportation Corp. American Locomotive Corp., 30 Church St., New York 8, N. Y.

Circle No. **12** *on Reply Card*

Grease Roll Tester Meets Shell Rolling and Military Specs

. . . by redesign to provide new features including temperature control from room to 175° F. with approximately ±1° F. accuracy, interchangeable drive mechanism sprockers for speeds of 10 to 160 rpm, and other items. The "Mil-Shell Roll" grease tester is used to measure the tendency of lubricating greases to liquefy in service. It is applicable for lubricant testing laboratories of both producers and users of lubricating greases. Pre-

Thirty Million B.T.U. CAPACITY

Cooling in Chemical Processes with Precise Control of Temperature

The NIAGARA Aero HEAT EXCHANGER cools liquids and gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. You save 95% of cost of cooling water; you make great savings in pumping, piping, power; quickly recover your installation cost.

You can cool and hold accurately the temperature of all fluids, air and gases, water, oils, solutions, chemical intermediates, coolants for mechanical, electrical and thermal processes. You obtain closed system cooling free from dirt. You solve all the problems of water availability, quality or temperature.

In CHEMICAL PROCESSES this is successfully used in cooling liquids and gases, chemical reactions, condensing distillations and reflux cooling.

Write for complete information; ask for Bulletins 120 and 124. Address Dept. PP.

NIAGARA BLOWER COMPANY

405 Lexington Ave. New York 17, N.Y.

District Engineers in Principal Cities of United States and Canada

To the Employee Relations Director of every American company

LET'S FACE IT . . . the threat of war and the atom bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, may strike without warning.

The very lives of your employees are at stake. Yours is a grave responsibility. Consider what may happen.

When the emergency comes, everybody's going to need help at the same time. It may be hours before outside aid reaches you. The best chance of survival for your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. To be unprepared is to gamble with human lives. Disaster may happen TOMORROW. Insist that these simple precautions are taken TODAY:

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's entirely integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here again, your CD Director can help—with advice on supplies needed for injuries due to blast, radiation, etc.

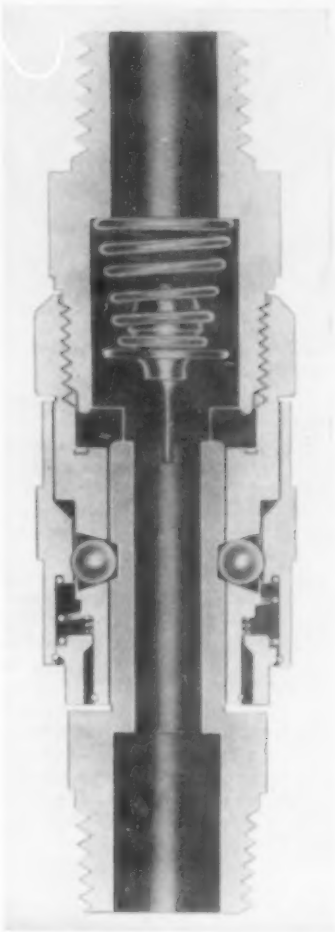
☐ **Encourage personnel** to attend Red Cross First Aid Training Courses.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good employee relations—and no greater way of helping America.

Act now . . . check off these four simple points . . . before it's too late.

cision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Circle No. **13** *on Reply Card*



Quick-Connect Hose Couplings Will Fit Instrument Lines

. . . without turning or twisting to lock. The "Pushomatic" automatically locks upon pushing into fitting, making a high pressure leakproof connection. An integral check valve shuts off the line or hose pressure when disconnected to prevent danger of backlash or whipping. Available in a variety of styles and types in sizes from ⅛ in. through ¾ in. for applications up to 10,000 psi. "Series 1A" was designed specifically for instrumentation, manifold and panel installation where space is limited. "Series 2A" is for pneumatic tools, air, water and hydraulic supply lines. Perfecting Service Co., Breco Div., 332 Atando Ave., Charlotte 6, N.C.

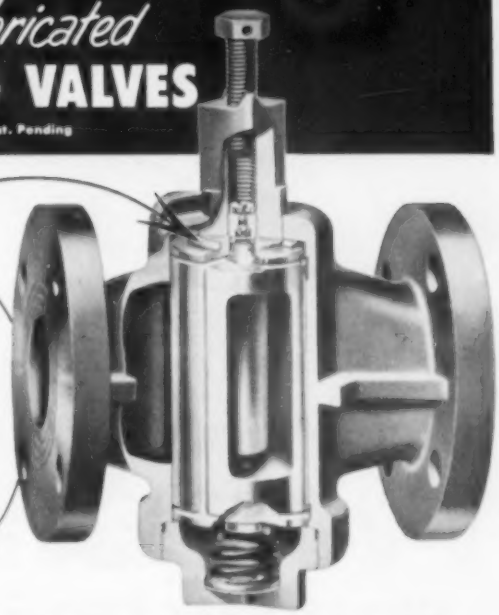
Circle No. **14** *on Reply Card*

No. 1* of . . .

12 REASONS WHY
YOU SHOULD BUY AND USE
LOW-PRICED

HOMESTEAD
Lubricated PLUG VALVES

Pat. Pending



* **EVERY HOMESTEAD LUBRICATED PLUG VALVE HAS A REINFORCED TEFLON HEAD SEAL**

. . . which will not cold-flow, and which provides a positive seal against leakage—even under 200 pounds pressure per square inch, *without lubrication*.

This is only **ONE REASON WHY** you should buy and use, *low priced* **HOMESTEAD LUBRICATED PLUG VALVES.**

HERE ARE ALL TWELVE

1. Reinforced Teflon packing ring.
2. Completely controlled high-pressure lubricant system.
3. 100% pipe area and venturi patterns.
4. No spring torsional stress.
5. No mechanical adjustments.
6. Two lubricants handle most services.
7. Extremely close tolerance between sealing surfaces.
8. Triple head-seal with Lubricant and Teflon packing ring.
9. Plug floated on Teflon surfaces.
10. Leak-proof, double-ball-and-lubricant-sealed check valve.
11. Full-threaded screw assures clean lubricant.
12. Extruded lubricant shows a full protecting system.

FOR CATALOG AND COMPLETE DETAILS MAIL COUPON TODAY

Without obligation, send Reference Book 39—Section 5 on HOMESTEAD LUBRICATED PLUG VALVES.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

HOMESTEAD VALVE MANUFACTURING COMPANY

"Serving Since 1892"

P. O. BOX 43 CORAOPOLIS, PA.

(To obtain more data on advertised products see page 264)

Why you cut more pipe more easily with RIDGID Heavy-Duty Pipe Cutters

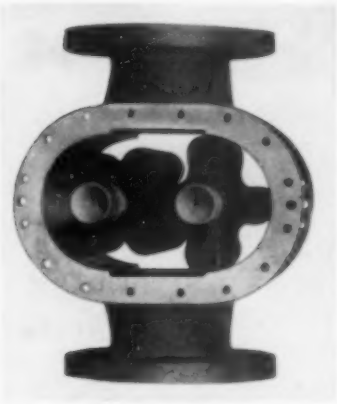
Extra easy to use—beautifully balanced, you work with least effort . . . high alloy thin blade or heavy-duty cutting wheels roll right thru any pipe, almost burrless cuts . . . perfect tracking.

Extra long service—special malleable housings guaranteed not to warp or break . . . every cutter individually tested before shipment, all 6 sizes—⅛" to 6"; 4-wheel cutters to 4".

For most for your money, buy RIDGID . . . Your local Supply House stocks them for you, gets them to you fast as you need them.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

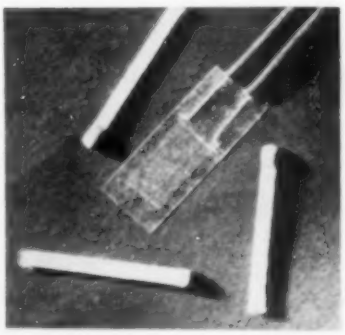
RIDGID
Work-Saver Pipe Tools



Positive Displacement Pump Uses Rubber Impellers

. . . and can handle water or high viscosity fluids having up to 78% solid content. Operating efficiency is 92%. In operation the unmeshing of the rubber impellers produces a vacuum drawing the liquid into the space between the lobes. The liquid is carried between the lobes and case housing to the opposite side of the pump, then forced into the discharge line. Liquid passes through the pump with a minimum of energy loss from turbulence and friction. Impellers may be replaced quickly without breaking lines. The pumps are self-priming and self-lubricating, and will not cavitate or vapor lock. Pump action will not break up semi-solids or aerate liquids, and they are fully reversible. Lindquist Pump Corp., 10001 W. Jefferson Blvd., Culver City 12, Calif.

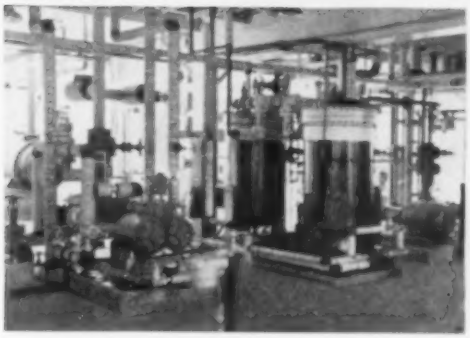
Circle No. **15** *on Reply Card*



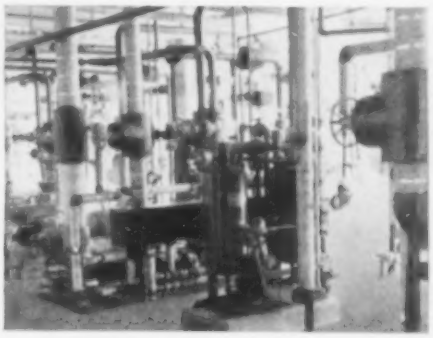
Resistance Thermometer Element Cements to Surfaces for Use

. . . and permits short term use at 600° F. Operating range is from —100° F. to +500° F. Construction is of a temperature-sensitive grid of very fine nickel wire bonded between

Lectrodryers DRY on-stream at British-American's new catalytic cracker



This BWC-750 Lectrodryer is DRYing propane at 250 psi, to a dewpoint of minus 20° F.



Bleed gas is recycled through the process after being dried by this BY-O Lectrodryer

Lectrodryers, as you see here at British-American Oil Company's new catalytic cracker at Clarkson, Ontario, fit right into a process where DRYing is required. Their capacity is suited to the task at hand; a few cubic feet per hour or thousands, atmospheric pressure or as high as 6,000 psi. They DRY air, gases and organic liquids.

While one section of a Lectrodryer* is on-stream, DRYing, the other is being regenerated. Then manually or automatically, after a suitable period, a valve is thrown and the other section is put to work. Thus the DRY-ing function goes on hour after hour, year after year, without interruption or falling off in efficiency.

You determine *where* you need DRYing. Then ask our engineers *how* to accomplish it. Quite likely there's a standard Lectrodryer that can handle the job. For a free copy of Bulletin 109, describing the different types and sizes of Lectrodryers, write Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birtac, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

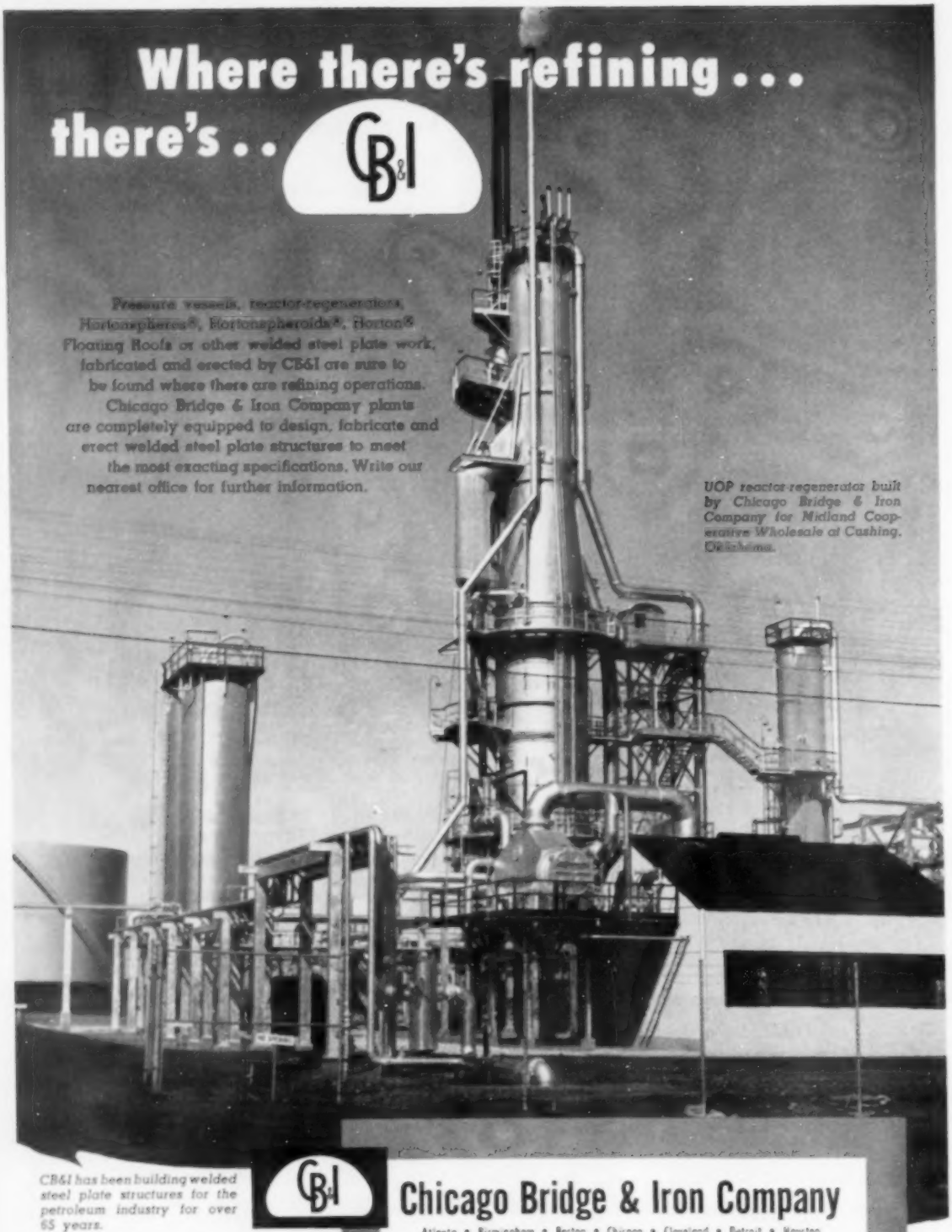
LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

Where there's refining . . .
there's . . CB&I

Pressure vessels, reactor-regenerators, Hortonspheres®, Hortonspheroids®, Horton® Floating Roofs or other welded steel plate work, fabricated and erected by CB&I are sure to be found where there are refining operations. Chicago Bridge & Iron Company plants are completely equipped to design, fabricate and erect welded steel plate structures to meet the most exacting specifications. Write our nearest office for further information.



UOP reactor-regenerator built by Chicago Bridge & Iron Company for Midland Cooperative Wholesale at Cushing, Oklahoma.

CB&I has been building welded steel plate structures for the petroleum industry for over 65 years.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
Los Angeles • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • Tulsa • Washington
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

two paper-thin wafers of silicone-impregnated glass-fiber fabric. The element is flat, thin, and flexible, so that with proper cements, it becomes an almost integral part of surfaces to which it is attached. The element is unaffected by shock or vibration and may be used to actuate direct reading indicators, recorders, or various types of controllers. With a thickness of ten thousandths of an inch, and with width and length 9/16th in. and 1-7/16 in. respectively, the "Type SN-1 Stikon" weighs about 2 grains. At 70° F. the resistance is 100 ohms. Manufacturing tolerance is ± 2 ohms and each element is marked to the nearest 0.5 ohm. Ruge-De Forest, Inc., 50 Moulton St., Cambridge 38, Mass.

Circle No. **16** *on Reply Card*

Graphite Bayonet Heat Exchanger Is Reinforced

. . . for greater strength. The "Camac Karbate" bayonet heat exchanger has no flanges in order to minimize the required installation area. Condensate is removed by a small internal steel pipe riser and the joint between the header and the Karbate tube is heavily reinforced with fiberglas. Heat transfer rates are excellent allowing savings in space. They can be used for either cooling or heating or alternately for both, as Karbate is unaffected by thermal shock. Units are stock items available in any length up to 6 ft. Carl Buck & Associates, Essex Fells, N.J.

Circle No. **17** *on Reply Card*

MEASURE, CONTROL LIQUID DENSITY
continuously and automatically with the

Princo Densitrol PRINCO

Process industries will welcome the new DENSITROL—the precision instrument that gives a continuous reading of density in flowing liquids such as sugar syrups, brine, acids. DENSITROL electrical indicators or recorders can be located remote from the sampling chamber itself. If desired, DENSITROL can be linked with control mechanisms for automatic regulation. For information on temperature and pressure ranges, calibrations, and other specifics, request Bulletin W-3.

PRECISION THERMOMETER & INSTRUMENT CO.
1434 Brandywine Street, Philadelphia 30, Pa.

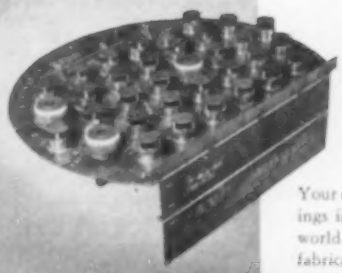
GLITSCH

BUBBLE CAPS...

ANY SHAPE
ANY SIZE . . .

Existing dies of 287 different cap and riser designs, as well as data on various ratios of related areas, are available to your engineers during planning stages. Practical ideas for improvements to keep apace constantly changing petroleum refining and chemical processing are a GLITSCH service of world-wide proportions.

GLITSCH "TRUSS-TYPE" TRAYS



Lightweight, simple, adaptable with complete freedom of layout, GLITSCH "Truss-Type" mechanical design is not restricted to standardized patterns. You specify your process requirements.

Your engineering staff can effect definite savings in initial designing through GLITSCH world-wide experience in plans, design and fabrication of tower internals.

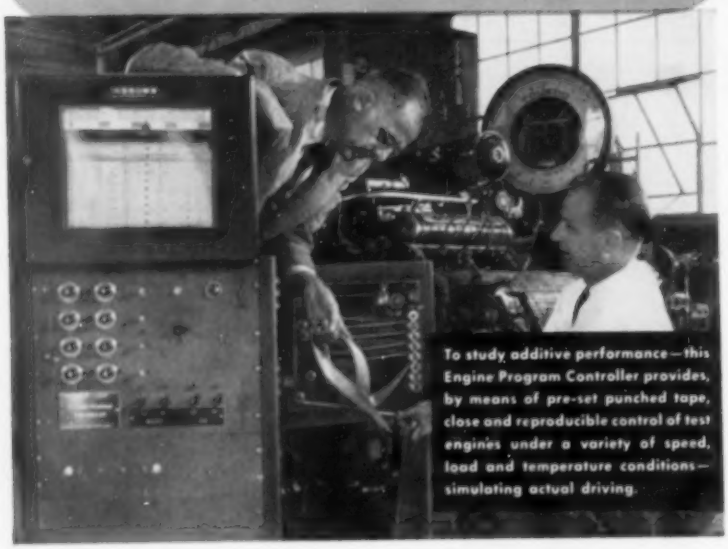
Cost analyses of tower internal equipment for fabrication in a wide range of material are available promptly.

Glitsch
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS

SALES OFFICES: New York • Chicago • Cleveland • Houston • Tulsa • Los Angeles

(To obtain more data on advertised products see page 264)

Ask about Oronite's "custom-formulation" of lube oil additives



To study additive performance—this Engine Program Controller provides, by means of pre-set punched tape, close and reproducible control of test engines under a variety of speed, load and temperature conditions—simulating actual driving.

Better oil performance at a competitive treating cost

Oronite specializes in "custom-formulating" additives to your exact needs—meeting your price and performance specifications. Because of Oronite's advanced research, testing and manufacturing facilities, custom-compounding has been accomplished at progressively lower treating costs.

With a years-ahead additive program it is possible that Oronite could provide your finished oil with competitive advantages you need to win and hold a market.

Why not talk it over with an Oronite additive specialist. Contact our office nearest you.

With Oronite Additives you can formulate oils to meet the new A.P.I. Service Classifications and can meet specifications for 2-104-B, MIL-O-2104, Supplement 1 and Series 2 oils.

OTHER ORONITE PRODUCTS
Gas Odorants
Polybutenes
Phenol
Wetting Agents
Fuel Oil Additives

ORONITE CHEMICAL COMPANY
200 Bush Street, San Francisco 20, California
30 Rockefeller Plaza, New York 20, New York
20 North Wacker Drive, Chicago 6, Illinois
714 W. Olympic Blvd., Los Angeles 15, California
Mercantile Securities Building, Dallas 1, Texas

ORONITE CHEMICAL COMPANY

New Seatless, Light Weight Valve Is Quick Acting

. . . and is made of stainless steel, inconel, monel, brass, bronze, aluminum, or alloys for any standard connections. A 270° turn is sufficient for on or off. Valve seal is provided by an O-ring and sock which are the only wear points in the valve. Parts are interchangeable to reduce spare parts inventory. Suggested applications are in the oil, chemical, food and beverage, distilling, and other industries. It combines the simplicity of the globe valve, the cleanliness of the plug valve, and the flow characteristics of the gate valve. Lint and small foreign particles will not affect the valve closure. Available in three body types, the line and angle and a special type for gravity drainage from tanks. A 1½ in. "Hemco" valve weighs only two pounds, making it applicable for use with glass lines. Hurt Corp., 997 S. Marengo, Pasadena, Calif.

Circle No. **18** *on Reply Card*

Free Trade Literature

Ammonia Synthesis Process

. . . using natural gas or practically any refinery gas, saturated or unsaturated: *Bulletin No. 0-54-1* gives descriptions, flow diagrams, and process data for the six stages in the processing sequence. Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **19** *on Reply Card*

Continuous Blowdown Savings

. . . through heat recovery and proper heat exchanger size with properly designed, automatic, continuous system by using simplified chart for rapid calculations. Henszey Co., Watertown, Wisc.

Circle No. **20** *on Reply Card*

(To obtain more data on advertised products see page 264)

Cyanamid's Aerocat Triple A* HIGH ALUMINA CATALYST is now available in commercial quantities

The world's first commercially-proved High Alumina Catalyst (25%) offers superior activity stability, lower stack losses and excellent selectivity . . .

Cyanamid is pleased to announce that production facilities to manufacture AEROCAT TRIPLE A High Alumina Catalyst in commercial quantities have been completed. We are pleased, also, with the immediate and growing acceptance this important new catalyst has received from the refining industry.

AEROCAT TRIPLE A has an alumina content of 25% by weight. Laboratory research indicated this higher amount of alumina could be incorporated into fluid catalyst by special techniques so as to offer several important advantages over regular 13% alumina catalysts. These indications were fully proved by more than a year's successful trial performance in a commercial fluid unit at a major oil refinery. These advantages include:

Superior Activity Stability – AEROCAT TRIPLE A showed a consistent equilibrium activity 15-25% higher than 13% alumina catalyst. This means higher cracking efficiencies.

Lower Stack Loss – AEROCAT TRIPLE A gave a considerable reduction in the quantity of catalyst lost from the regenerator stack. For most operations, a reduction of 20% or more can be expected. This feature provides more effective retention of fresh catalyst additions and gives flexibility to withdraw and discard inactive or contaminated catalyst.

Excellent Selectivity – AEROCAT TRIPLE A gave product distribution equal to that of 13% alumina catalyst. With some feed stocks, tests have shown *improved* selectivity with Triple A.

By using AEROCAT TRIPLE A High Alumina Catalyst, you now have the money-saving choice of: (1) increasing output volume per ton of catalyst; or (2) improving performance at the same catalyst usage rate. Both mean lower catalyst cost to you.

Contact your Cyanamid representative for full details on this important new catalyst development.

*Trade-mark

Aerocat Triple A*
High Alumina Catalyst

AMERICAN Cyanamid COMPANY
Refinery Chemicals Department
30 Rockefeller Plaza, New York 20, N. Y.

In Canada: North American Cyanamid Limited, Toronto and Montreal

(To obtain more data on advertised products see page 264)

Two famous engineering firms join forces to pool their process experience and resources . . .

The Fluor Corporation, Ltd., Los Angeles, has purchased an interest in Singmaster & Breyer, Inc., New York City, an engineering firm with approximately 300 employees. Established in 1927, Singmaster & Breyer, Inc. has specialized in process engineering for the chemical, petrochemical and metallurgical industries.

Since 1890, Fluor has served the petroleum, natural gas, chemical, power and allied fields with engineering, construction and manufacture of specialized products. Fluor also places special emphasis on process developments.

Each firm will retain its own identity and personnel who will work closely together on mutual projects, fusing their extensive knowledge and experience for greater service to their clients both at home and abroad.

BE SURE WITH **FLUOR**

THE FLUOR CORPORATION, LTD
LOS ANGELES 22, CALIFORNIA
FLUOR OF CANADA - TORONTO
FLUOR PERUANA, S. A. - LIMA
HEAD WRIGHTSON - LONDON

ENGINEERS
CONSTRUCTORS
MANUFACTURERS

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

(To obtain more data on advertised products see page 264)

Selection of Stainless Valves

. . . with seventy-five questions and answers to aid in the selection and maintenance of stainless steel valves; *Valves to Combat Corrosion* covers selection of materials, data on new materials, service and installation problems and information on valve repair. The Cooper Alloy Foundry Co., Hillside, N. J.

Circle No. **21** *on Reply Card*

Jet Apparatus and Applications

. . . to help engineers select the right type of jet apparatus for specific requirements; *Bulletin J-1* discusses jet principles, terminology, construction, operation, advantages, and applications with drawings. Schutte and Koerting Co., Dept. J-Q, Cornwells Heights, Bucks County, Pa.

Circle No. **22** *on Reply Card*

Ultrasonic Thickness Testers

. . . for corrosion inspection on tanks, pressure vessels, piping, etc., are portable and battery powered: *Catalog A-2* describes the "Audigage" and its uses. Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn.

Circle No. **23** *on Reply Card*

Ethyl Benzene Technical Data

. . . concerning physical, chemical, physiological properties; specifications; suggested applications and typical reactions in technical bulletin *F-8596*. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **24** *on Reply Card*

Clad vs. Solid Alloy Costs

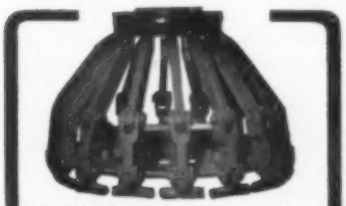
. . . for 16 standard alloy claddings on a variety of backing steels: *Form No. 718* gives cost savings realizable from alloy cladding on process equipment and other advantages. Lukens Steel Co., Coatesville, Pa.

Circle No. **25** *on Reply Card*

Corrosion Control by Stainless

. . . tubing and pipe: 28-page *T.D. 113* contains corrosion resistance tables, charts, user field reports, test results and other engineering information for many standard stainless alloys and several super corrosion-resistant steels with a description of main types of corrosion and basic applications for stainless tubing and pipe in anti-corrosion service for varying conditions. The Carpenter Steel Co., Alloy Tube Div., Union, N. J.

Circle No. **26** *on Reply Card*



BARRETT automatic

Filling and Crimping Equipment

for handling greases and other viscous fluids.

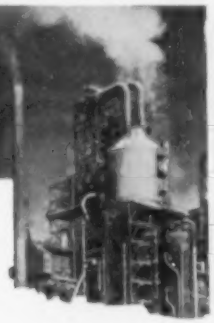
- No operator required.
- 100% air operated.

Fills, seals, stamps and counts lug cover pails. Output of 15 pails per minute. Write for details on installation to meet your requirements.

BARRETT
Manufacturing Co.
P. O. Box 8096, Houston 4, Texas

4590

"Alamask"



offers a complete and diversified line of reodorants for petroleum and allied products

No longer need the products of the petroleum industry inflict upon their users the obnoxious odors resulting from the mercaptans and sulfides in their processing.

Years of development work and product-testing have culminated in a complete line of Alamask® reodorants that can successfully mask the objectionable odors of many petroleum products. Check this table to see which Alamask reodorants will solve your malodor problems:

"ALAMASK"	GASOLINE FRACTIONS	ASPHALTIC COMPOUNDS	KEROSENE BLENDS	COAL SPRAY OILS	SPACE HEATERS	CUTTING OILS	CLUTCH OILS	DIESEL FUELS	JET FLUIDS	MINERAL SPIRITS	WAXES	NAPHTHA	BURNER OILS
AAM								X					
AO						X	X						
AR		X								X			
BGM		X											
BN						X	X						X
BUL				X	X			X			X		X
CC			X							X			
CE			X							X			
CX											X		
MS			X							X	X	X	X
0.19	X				X	X	X		X				X
0.20	X				X	X	X		X				X
TO									X				

Rhodia's chemists and engineers, experienced in odor abatement and waste disposal, will provide technical assistance to you in your efforts to correct malodors.

For complete information on these new, highly-effective reodorants, write today to Rhodia, Inc., Industrial Reodorants ("Alamask") Division, 230 Park Avenue, New York 17, N. Y.

Rhodia INC.

(To obtain more data on advertised products see page 264)

Electronic Liquid Gaugers

. . . for storage tanks and pipelines: *Application Data Sheet 102* describes and illustrates principles of operation, equipment, circuitry and use of the "Helipot" in telemetering systems. Helipot Corp., South Pasadena, Calif.

Circle No. **27** *on Reply Card*

Acetone Technical Data

. . . for the process industries: *Data Folder F-8650* includes physical and physiological properties, specifications, constant-boiling mixtures, general solvent properties, resin solubilities, and general uses. Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.

Circle No. **28** *on Reply Card*

Electrical Precipitation

. . . of solid particles from gases: 28-page bulletin discusses electrical precipitation equipment, principles of electrical precipitation, applications to oil refineries, carbon black, power plants, etc., and gives installation photographs and diagrams. Research-Cottrell, Inc., Bound Brook, N. J.

Circle No. **29** *on Reply Card*

Chemical Cleaning of Equipment

. . . in petroleum industry: 14-page indexed manual gives detailed directions for 28 different cleaning and safety procedures for production, processing, storage, transportation, marketing and salvage operations. Wyandotte Chemicals Corp., Wyandotte, Mich.

Circle No. **30** *on Reply Card*

Automatic Fuel Oil Blending

. . . continuously: *Application Memo L-25* illustrates a two component blender to deliver a uniform blend of #5 fuel oil directly to tank trucks, tank cars, ships, or storage—contains flow diagram and equipment description. Proportioneers, Inc., Providence, R. I.

Circle No. **31** *on Reply Card*

Cooling Tower Water pH Control

. . . and measurement for conservation of make-up water, wood protection, prevention of scale, and minimization of slime: *Process Data Sheet 700(1)* offers suggestions on methods and equipment for this application. Leeds & Northrup Co., 444 N. 16th St., Philadelphia 30, Pa.

Circle No. **32** *on Reply Card*

Molybdenum Thermodynamics

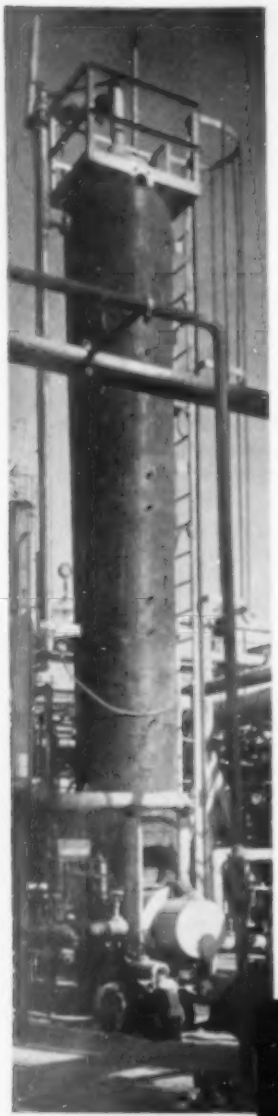
. . . for the metal and its more important compounds: *Bulletin Cdb-2* is the result of a comprehensive literature search of the past twenty years covering molybdenum and compounds of oxygen, sulfur, carbon, nitrogen, silicon, fluoride, chloride and other halides. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

Circle No. **33** *on Reply Card*

Gas Engine Driven Compressors

. . . of 2-cycle turbocharged design for greater power and lower operation costs: *Bulletin 134 and Form 135* discuss principles of operation, savings in installation and operating costs, general advantages, specifications, and the turbocharging of the "TLA" compressor. Clark Bros. Co., Olean, N. Y.

Circle No. **34** *on Reply Card*



Texas Refinery Cuts Tower Cleaning Time 79%

¶ **REMOVING** asphaltic deposits from 45 foot absorber tower previously took 4 days. Estimated production loss due to shut-down: $28,800.
¶ **INTRODUCTION** of Oakite chemical circulation method of cleaning involving rapid-action Oakite detergents cut time to 20 hours. Brought production loss down to less than one day. Actual cost of cleaning with Oakite method only one third of former manual method. ¶ **THIS IS BUT** one example of the kind of savings you can realize with tested Oakite methods.
And it's only one of many Petroleum cleaning operations you'll find concisely discussed in the FREE booklet, "What Petroleum Men Should Know To Simplify Cleaning." ¶ **ITS 48 PAGES** are packed with ideas for saving money, increasing production. Ask your Oakite Representative for a copy.
Or write Oakite Products, Inc., 50D Rector Street, New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. and Canada

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

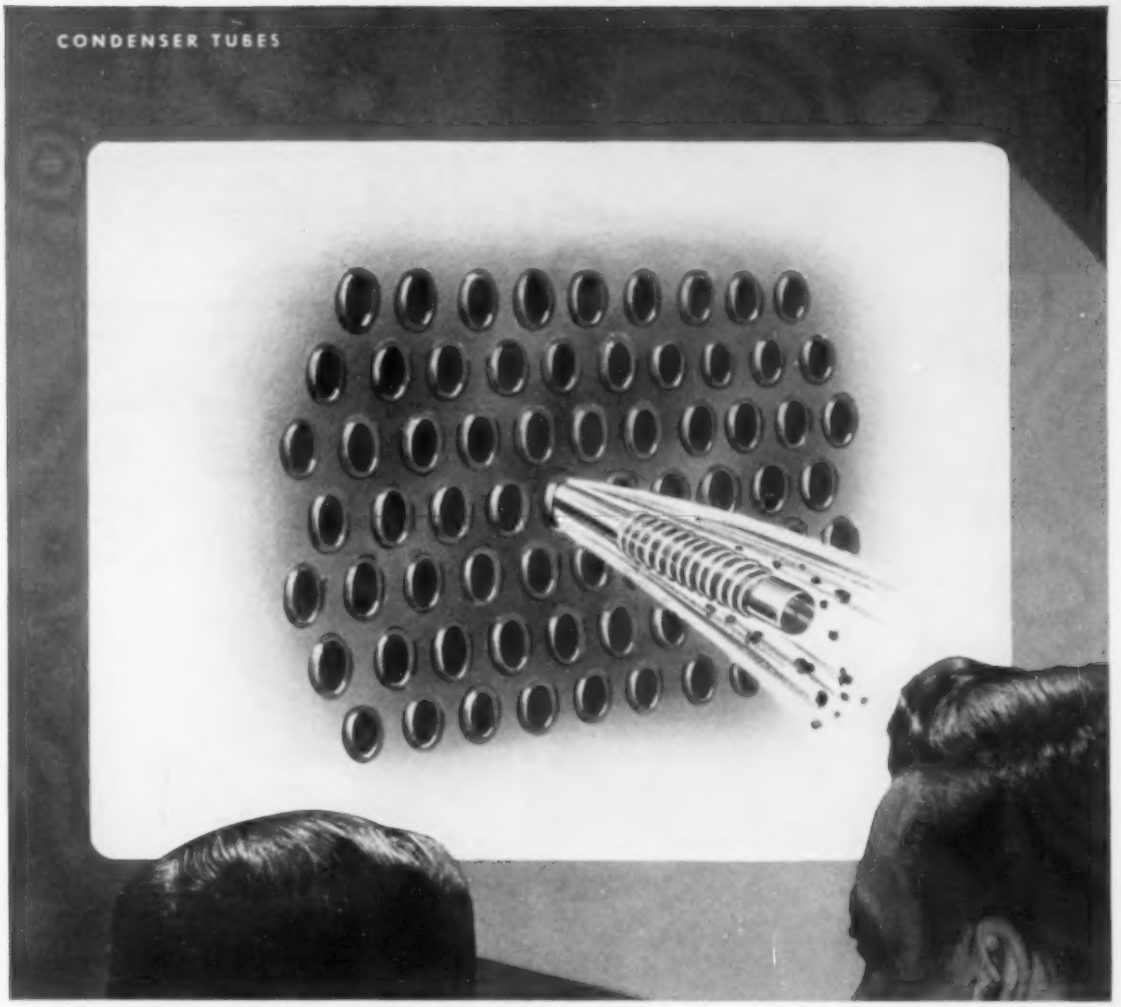


Illustration shows how short bristle brushes—shot through tubes by a high-pressure water stream—remove loose deposits.

COOLING WATER: how its composition affects life of condenser tubes

You can't always pick your plant site where water is noncorrosive. Economics may not permit it. If your plant is located inland, cooling waters generally will be relatively noncorrosive. Tide water plants, however, will have corrosion problems, particularly if the sea water is polluted with industrial or domestic wastes. This is especially true if the organic matter in the sewage is able to ferment under anaerobic conditions. Then sulfides are likely to form. In an enclosed harbor or in a dead-end channel, water may be more or less stagnant. There it is particularly subject to infestation by anaerobic bacteria.

Frequent cleaning of tubes will remove slimes containing bacteria. At the same time it will remove sulfide scales and increase tube life. You can also remove slimes by chlorinating polluted water frequently. This may aid in breaking down unwanted sulfide films on the inner walls of the condenser tubes.

In some cases you can dredge the channel bottom near the water intake to remove accumulations of decaying vegetable matter. This will help to maintain longer tube life.

Cooling water is only one factor affecting tube life. Publication B-2 "Anaconda Tubes and Plates for Condensers and Heat Exchangers," discusses *all* the important operational factors, and gives much other useful information. And, of course, our Technical Department stands ready to assist you in the selection of tube alloys from our extensive line. *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

64504

ANACONDA®

Tubes and Plates for Condensers and Heat Exchangers

Arsenical Admiralty-439; Ambraloy-927; Cupro Nickel, 30%-702, and other copper alloys.*

*U. S. Patent No. 2,003,685 [Orig.]

 (To obtain more data on advertised products see page 264)

How To Solve Corrosion Problems

PROBLEM: Protecting a preheater from corrosive attack during periodic contact with hydrochloric acid, trichlor benzene, and other chlorine compounds at 300 deg. F.

REMEDY: Complete lining with HASTELLOY alloy C 11-gage sheet.

RESULT: The vessel has given four years' service and is still going strong.

PROBLEM: Valving sulphur-laden flue gas at 800 deg. F. and 300 psi.

REMEDY: A ¼-in. layer of HASTELLOY alloy B was applied to seats and seating surfaces.

RESULT: The valves gave over four years' service despite the corrosive conditions.

Free: Money-saving jobs like these are described in detail in the monthly magazine HAYNES ALLOYS DIGEST. To receive a copy regularly, write Editor, HAYNES ALLOYS DIGEST, Room 308, 30 East 42nd Street, New York 17, New York.

HASTELLOY *alloys*

Trade-Mark

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

Haynes Stellite Company
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Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
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What's New!

Magnetic Particle Test Unit

. . . for checking ferrous metal objects for surface discontinuities is portable: bulletin *RC-135-5M* gives photos, drawings and diagrams for a description of basic principles in magnetic particle testing with the "Portaflux." North American Philips Co., 750 E. Fulton Ave., Mount Vernon, N. Y.

Circle No. **35** *on Reply Card*

Vertical Multi-Stage Pumps

. . . designed for refinery, process, booster, and boiler feed service for pressures up to 1500 psi and capacities to 3500 gpm: *Form 7096* gives drawings, specifications, applications, and advantages. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Circle No. **36** *on Reply Card*

Teflon Technical Data

. . . covering history, general characteristics, manufacture, compositions, uses, properties, molding, and other information in 60-page *"Teflon"* manual. E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.

Circle No. **37** *on Reply Card*

THE Quick Way TO ACCURATE VISCOSITY DETERMINATIONS

Yes, the new Brookfield booklet shown above contains 20 pages packed full of the latest "how-to-do-it" information. It could only have been prepared by the world's leading manufacturer of viscometers *after 15 years of specialized work on all sorts of rheological problems.* Send for your free copy today. Write Dept. W

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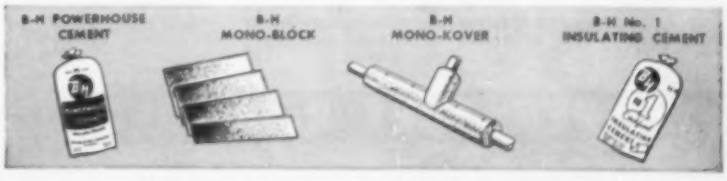

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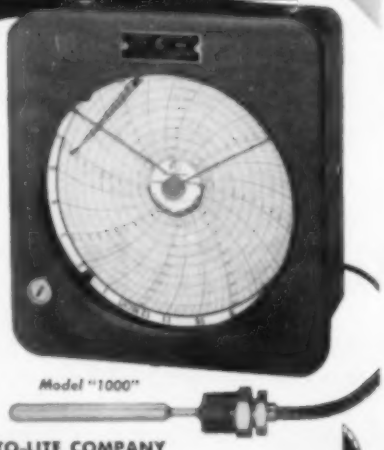

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TEMPERATURE RECORDERS

What's New!

Automatic Composition Analysis

. . . for as many as twelve elements in a sample of process material with an automatic multi-element indexing spectrometer: *Norelco Autrometer* describes principles of operation, performance, industry use, and the instrument components with a full-page block diagram. North American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.

Circle No. **38** *on Reply Card*

Siliceous Grease Thickeners

. . . with excellent resistance to thickener separation in presence of water: *Bulletin A-8273* discusses the "Estersil" thickeners, their development and evaluation, mechanical stability, water resistance, properties at elevated temperatures, oxidation stability, wear, anti-rust properties and compatibility. E. I. du Pont de Nemours & Co., Inc., Petroleum Chemicals Div., Wilmington, Del.

Circle No. **39** *on Reply Card*

Petroleum Processing Index

. . . for 1954: including subject and author indexes for all feature articles and regular departments for the 12 issues of this magazine published during the past year. Available now from Mc-Graw-Hill Petroleum Publications, 330 West 42nd St., New York 36, N. Y., or . . .

Circle No. **40** *on Reply Card*

Seal-Less Centrifugal Pumps

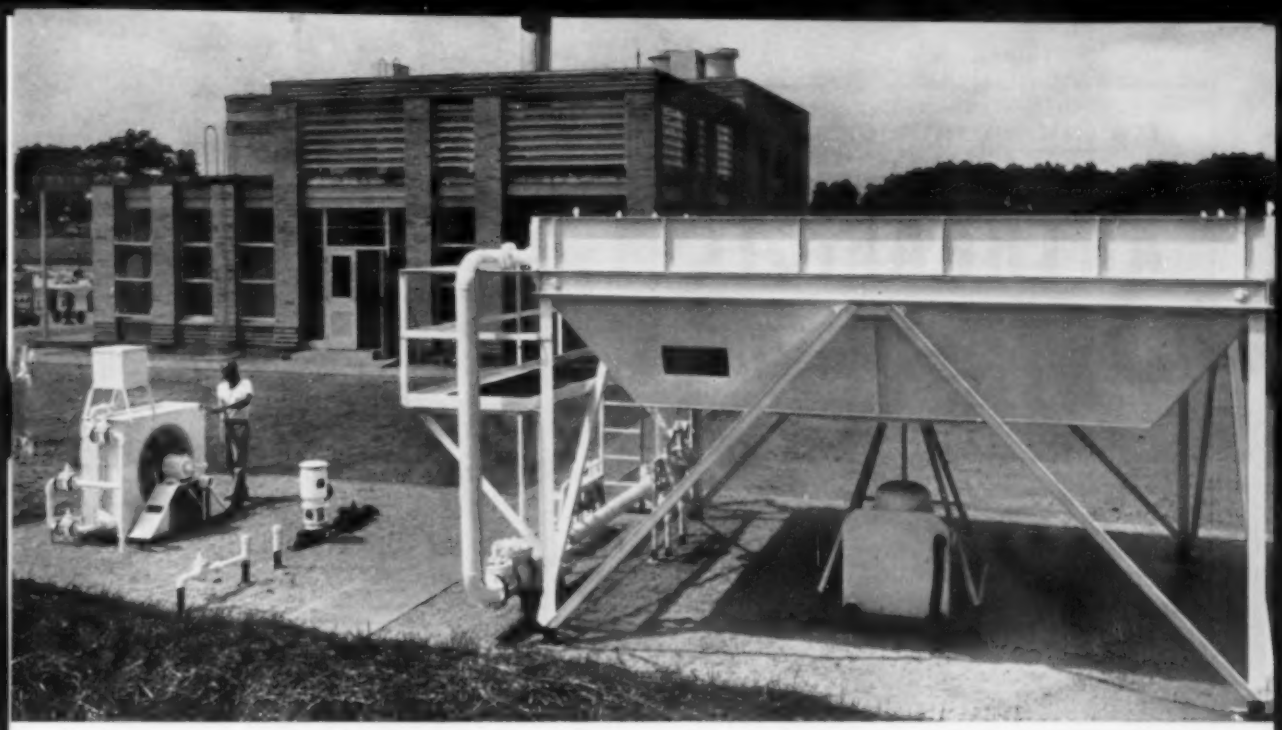
. . . reduce maintenance costs and pump leakage: *Design and Development of Seal-Less Pumps* covers design history, early experimental work, problems in building an electric motor inside a pump, and operational case histories. Chempump Corp., Station B, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle No. **41** *on Reply Card*

Vermiculite Data Book

. . . revision for 1955 for over 40 industrial applications: 16-page publication *G-81* describes the mineral's use in terms of its adsorption, catalytic, dielectric, filler, insulation, lubrication, resiliency and thermal expansion characteristics with a discussion of chemical and physical properties and a listing of pertinent literature. Zonolite Co., 135 S. LaSalle St., Chicago 3, Ill.

Circle No. **42** *on Reply Card*



TWO TRANE Fluid Coolers are used at this refined products pumping station at Vicksburg, Michigan. Model EC at left (horizontal air flow) cools hydraulic oil. Model GC at right (verticle air flow) cools jacket coolant, which in turn cools lube oil for Nordberg 2650 hp Diesel. Station is part of a system operated by Shell Oil Company as agent for Wolverine Pipe Line Company.

For continuous, unattended cooling duty

Trane fluid coolers are specified for remote control equipment stations like these

Ability to operate unattended—a major consideration in remote-control pumping stations—is the reason why TRANE Fluid Coolers have been specified for so many modern new pipeline installations. **TRANE Fluid Coolers** are dependable because they are rugged, simply designed, free from maintenance and adjustment problems . . . and these are important "pluses" for *any* cooling job you may have on your boards.

Modulation control is simple, trouble-free. Steel shutters work in unison with a two-speed motor. Complex variable-pitch fan mechanisms are eliminated.

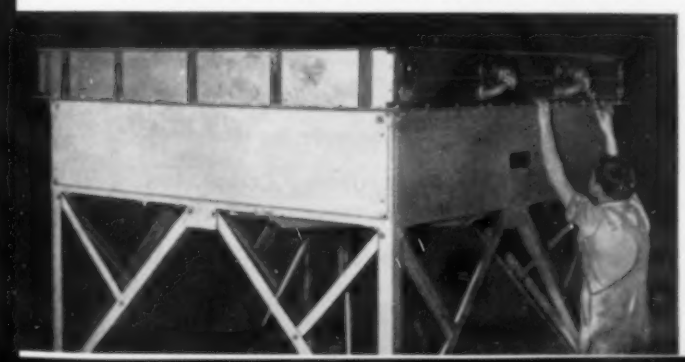
Vibration is isolated by mounting fan and motor independently of the unit.

Greater freeze-up protection. Heavy 14 ga. interlocking steel shutter blades are counterbalanced, powered from both ends to give tight closure, stop all convectional circulation.

Power consumption is cut as much as 65% because two-speed motors operate at half speed up to 80% of the time. *Leaving fluid temperatures* can be held to plus or minus 2°F.

For full information call your nearest TRANE Sales Office, or write TRANE, La Crosse, Wis.

Heart of a fluid cooler is the coil, and TRANE has over 30 years experience in all types of extended surface heat transfer equipment. Because TRANE makes its own coils, the heat transfer performance and horse power consumption of TRANE Fluid Coolers is a known quantity—accurately predictable in advance.



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A series of 8 articles by Cornelius E. Shannahan, instrument engineer with M. W. Kellogg Co., dealing with the four basic refinery instruments (pressure, temperature, flow, level), plus sections on controllers, control valves and pneumatic transmission—40 pages, 8¼ x 11¼, paper bound (1951-2) $1.00

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Works where an ordinary wrench won't!

This new REED wrench does everything a conventional pipe wrench will do, plus a great deal more. It gets into tight corners, close to baseboards or between parallel pipe lines and holds round, square or irregular shapes firmly, without "play" and without crushing. Its fast, ratchet action lets you turn either way from either side. You can tighten and "back-off" without taking the wrench from the pipe. 10", 14", 18", 24" and 36" lengths.

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What's New!

Largest Fluid Cat Cracker

. . . in the world at Shell Oil Co.'s Norco, La., refinery and the new $8 million ammonia processing plant for the Cooperative Farm Chemicals Assoc. in Lawrence, Kan., described in *Heat Engineering, Sept.-Oct., 1954.* Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **43** *on Reply Card*

Dihydroxy Diphenyl Sulfone

. . . as a promising ingredient in the production of heat-resistant epoxy and phenolic resins; *Technical Bulletin No. 0-118* gives suggested uses, properties, specifications, shipping information, chemical reactions, toxicity and safe handling information, and a bibliography. Monsanto Chemical Co., St. Louis 4, Mo.

Circle No. **44** *on Reply Card*

High-Purity Bulk Reagents

. . . for researchers and pilot-plant engineers: *Catalog 116-C* lists the analyses, shipment sizes, and prices for about 100 reagents and chemicals available in 100 to 600 pound drums. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **45** *on Reply Card*

Epoxy Resins and Hardeners

. . . for corrosion-resistant equipment and adhesive applications: 16-page *Booklet I-763* describes use of "C-8" epoxy resins, storage life, handling, working life, mixing, fillers, and cleaning equipment. Bakelite Co., 300 Madison Ave., New York 17, N. Y.

Circle No. **46** *on Reply Card*

Hot Lime-Hot Zeolite Process

. . . design problems and the prediction of chemical dosages and effluent results: *Technical Reprint T-120* describes the operation of the process and presents a simplified form for calculations using field and laboratory data. Graver Water Conditioning Co., 216 W. 14th St., New York 11, N. Y.

Circle No. **47** *on Reply Card*

Pfaudler Maintenance Manual

. . . revised pages for present holders of the manual change Foreward, History, Section 2, and Automatic Lubrication System sections. The Pfaudler Co., 1000 W. Ave., Rochester 3, N. Y.

Circle No. **48** *on Reply Card*

don't be HALF INFORMED

get a **DEMONSTRATION** of the **Airetool CC-4325**

Become acquainted with the remarkable results obtainable from this condenser cleaner . . . it's the lightest, most flexible and mobile condenser cleaner ever offered on the market!

Say goodbye to bulky, cumbersome condenser cleaning equipment . . . gain new speed in your operations with the feather-light new AIRETOOL CC-4325. It weighs only 11 lbs. and is easily handheld by one man, with no supporting rig required! A high-speed two-stage air motor provides extra power to rapidly and completely clean scaled tubes, even those completely plugged with hardest deposits.

The AIRETOOL No. CC-4325 Condenser Cleaner, and a carbide-tipped drill, form a combination that is really speedy and efficient. The built-in hand-controlled flushing system removes chips from the drill point as you work. A wide variety of drill and brush heads are available to meet every condenser cleaning need . . . they're quicker, safer and thorough in cleaning condenser tubes.

WRITE TODAY for complete details about the CC-4325 and other AIRETOOL Tube Cleaning and Expanding Equipment. Ask for your demonstration appointment!

Remember . . . there's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

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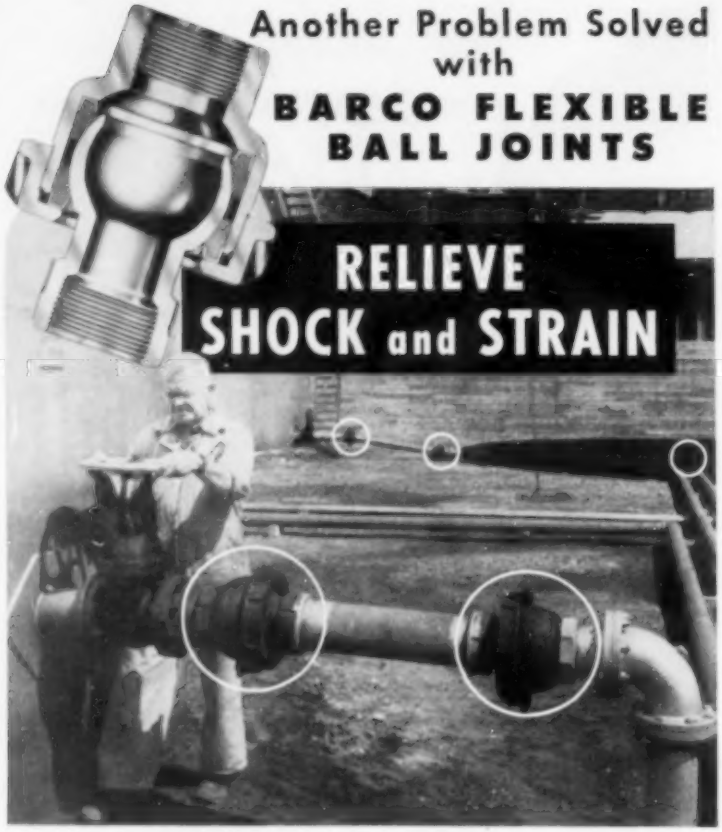

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2. **MAXIMUM FLEXIBILITY.** Up to 40° side flexibility with 360° rotating movement.
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THE Tidewater Associated Oil Company, in their tank farm at Tacoma, Washington, had to allow for tank settling and expansion and contraction of piping and also for protection of piping and valves in case of earthquake shocks. They solved this dangerous and costly problem by installing Barco Flexible Ball Joints, Style 7-8, as shown above.

This is one of the many, many applications of Barco Joints in practically every field of industry and transportation. By allowing movement through every angle, Barco Ball Joints absorb strain and stress, permit expansion and contraction, and act as insulation to prevent corrosion from electrolysis. Barco Joints also facilitate quick break-down and setting up of drill rig equipment. Furnished in high pressure as well as standard styles, with threaded, flanged, or welding ends; steel, malleable, or stainless. Fire-proof and capable of handling high temperatures. Write for full information and drawings of piping installations. Barco Manufacturing Co., 559C Hough Street, Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING AND REVOLVING JOINTS

Did You Miss These?

The following items, reviewed originally in November, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

Variable-Area Flow Meter Measures Gas or Liquid Flow

. . . for corrosive and non-corrosive systems. The in-line construction is pocket-free, permitting passage of soldis in suspension, slurries, and sludges. The meter design combines the installation simplicity of the differential orifice with the linear measurement signal, wide range, and low viscosity sensitivity of variable-area type meters. The yoke is provided with a mounting pad for field or factory attachment of micro-switches, pneumatic or electrical position transmitters or local controllers. Supplied for installation in pipe lines from ½ in. to 12 in., the meter handles flow rates of from 0.2 to 2,000 gpm liquid, from 10 to 60,000 lb./hr. steam, or from 1 to 6,000 cfm gas. The meter may be installed at any convenient angle. An essentially constant pressure drop through the entire flow range, as the area of the meter insert varies directly with flow rate, gives a linear measurement. Total available rangeability of each metering insert is 1 to 35. Construction may be almost any metallic or non-metallic material except glass and other unmachineables. Devicengineering Co., 1701 Walnut St., Philadelphia 3, Pa.

Circle No. **49** *on Reply Card*

Thermocouple for Pipe Surface Has Adjustable Pipe Clamp

. . . made of stainless steel with steel spring protecting the thermocouple terminal in the clamp. Recommended for reading outside pipe temperature whenever immersion thermocouples are undesirable, lines are not easily entered, or process flow cannot be interrupted; also for checking other temperature devices or insulation effectiveness, and obtaining temperature gradients by the use of multiple units. The unit is installed by placing the opened clamp around the pipe, slipping the band end into the worm gear housing, and tightening with a screw driver. The 20 gauge thermocouple lead wire is 18 ft. long, protected by

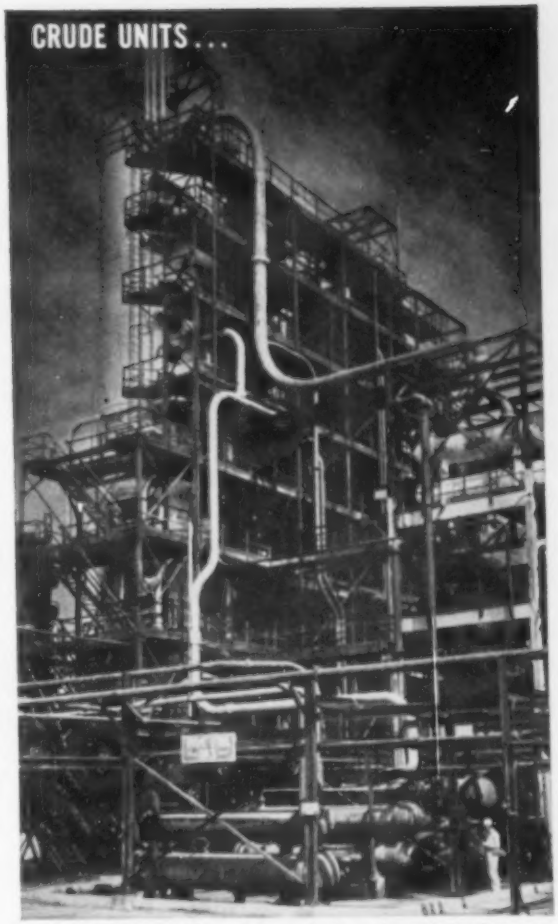
POLYRAD CONTROLS ACID CORROSION

all around the refinery

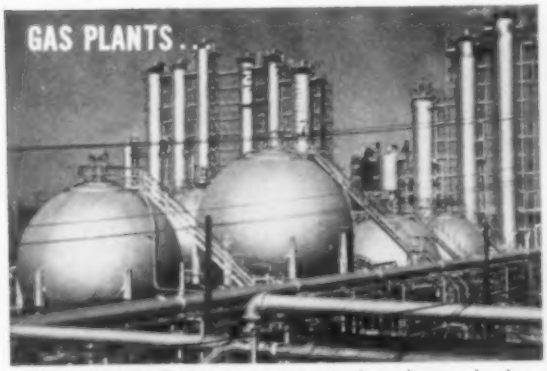
From crude units to gas plant areas, Hercules Polyrad controls corrosion, helps maintain throughput, increases heat transfer, reduces metal loss, and cuts down time for maintenance.

A filming amine inhibitor, Polyrad forms a protective molecular film that safeguards refinery equipment from hydrogen-ion attack by organic and inorganic acids. Developed through Hercules research, Polyrad was specifically designed to control corrosion at low pH and it is highly effective over the entire pH range encountered in refinery operations.

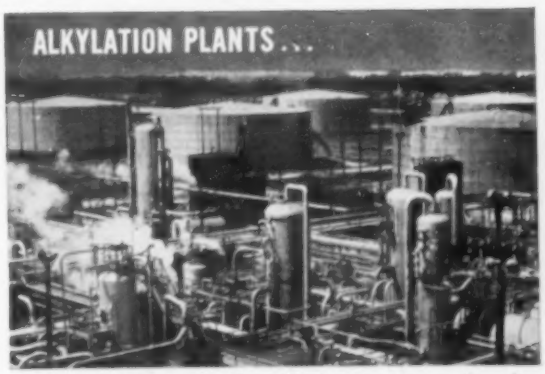
Polyrad is quickly available from stocks located strategically throughout the nation. One of our technical representatives will be glad to work with you in evaluating Polyrad under your operating conditions. For additional data, write Hercules.



A PLUS FEATURE of Polyrad through the refinery is its detergent action which loosens iron sulfide and other scales so that they can be removed in the fluid stream.



CUTS DOWNTIME—By helping to maintain throughput and reducing metal loss, Polyrad keeps down time for maintenance to a minimum any place in the refinery where acidic corrosion or fouling is a problem.



POLYRAD PROTECTS many types of refinery equipment from hydrogen-ion attack. It is useful in condensers, distillation columns, re-boilers, and heat exchangers.

Naval Stores Department

HERCULES POWDER COMPANY

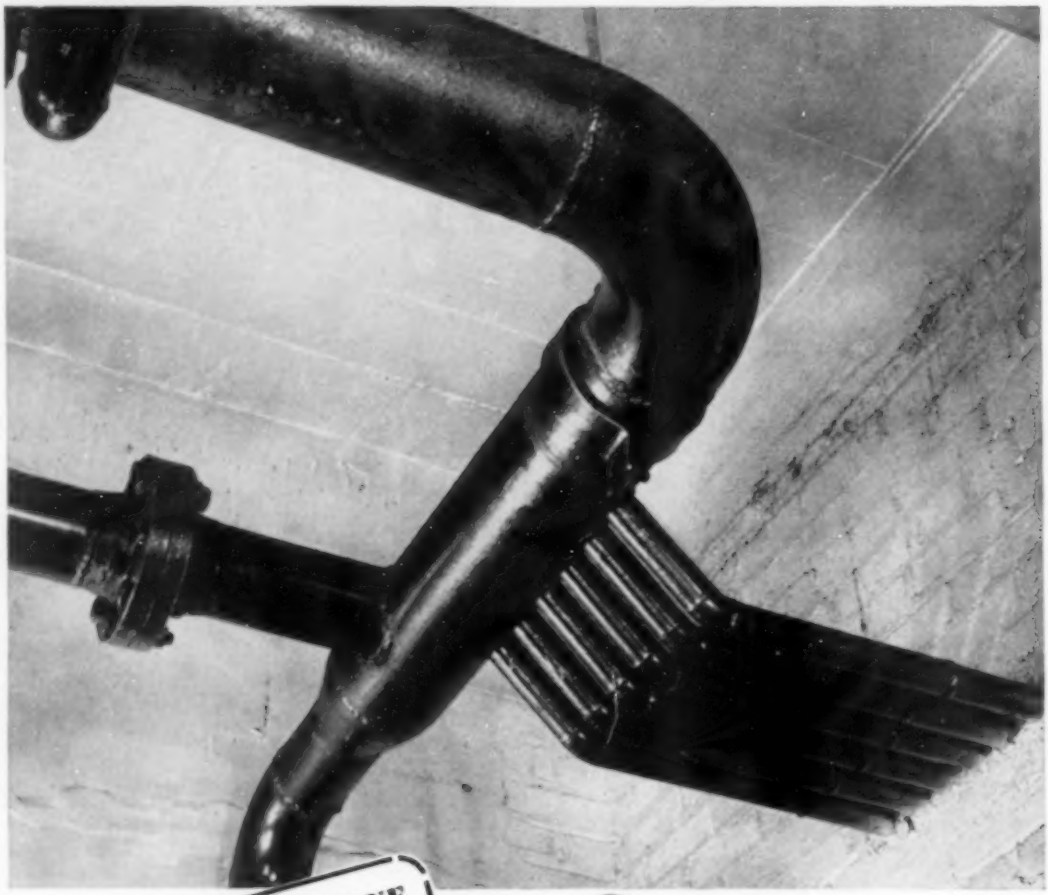
984 Market St., Wilmington 99, Del.

POLYRAD®

FILMING AMINE INHIBITOR

(To obtain more data on advertised products see page 264)

How to Tame a Tough Joint



ANOTHER JOB DONE BETTER WITH GLOBE WELDING FITTINGS

KEEP an eye on the future when you install piping—even the most innocent looking connection can become a "tough joint" through leakage — pressure-loss — the focal point for erosion and corrosion — constant maintenance time and cost.

You can tame probable "tough joints" in piping by making connections with permanently tight, leakproof Globe Welding Fittings. Strength is forged in the fittings — flow friction and pressure-loss minimized by precision formed true angles, radii, circularity—weight and space requirements reduced—exact dimensional accuracy that saves time, speeds piping assembly. To do any piping job better — use Globe Precision-Process Welding Fittings.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Fittings Department
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B&W SEAMLESS and WELDED TUBES

silicone-impregnated, glass over asbestos, waterproof insulation. Thermocouples come as copper-constantan for low temperatures or iron-constantan for temperatures up to 1000° F. Clamps are available for pipe sizes from ⅜-in. I.P.S. through 4 in. I.P.S. Conax Corp. 4515 Main St., Buffalo 21, N.Y.

Circle No. **50** *on Reply Card*

New Bubble Tray Design

. . . for distillation columns features simplicity and removability; *Bulletin 10-M* gives background, mechanical and process features, with chart for estimating the approximate cost for "Uniflex" trays. Badger Manufacturing Co., 230 Bent St., Cambridge 41, Mass.

Circle No. **51** *on Reply Card*

Pressure Vessel Codes

. . . compared on an over-all basis in a new 1954 supplement are the subject of a feature article by Walter Samans in the Fall, 1954, issue of *Alco Products Review*, continuing a discussion first published in the Spring, 1953, issue. Another article discusses Continental Oil Co.'s enlarged Lake Charles, La., refinery. American Locomotive Co., Schenectady 5, N.Y.

Circle No. **52** *on Reply Card*

Industrial Growth Trends

. . . in the chemical, plastics, and fertilizer industries; *Technology Behind Investment* estimates future prospects with reference to raw materials, processes, competition, markets, and prices. Arthur D. Little, Inc., 30 Memorial Drive, Cambridge 42, Mass.

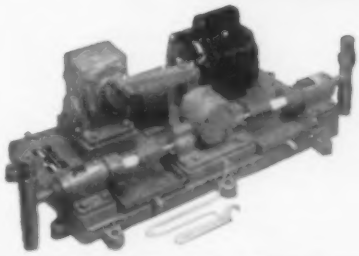
Circle No. **53** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items received in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.

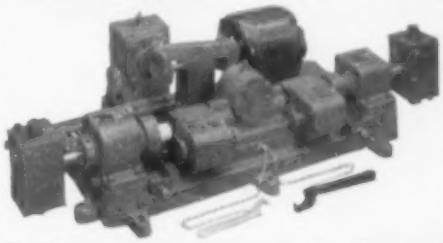
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



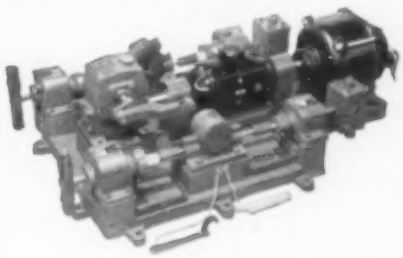
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



VARIABLE SPEED UNITS

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

Write for Catalog:

Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2448 W. Nelson St., Chicago 18, Ill.

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metering and proportioning pumps

Also Manufacturers of:
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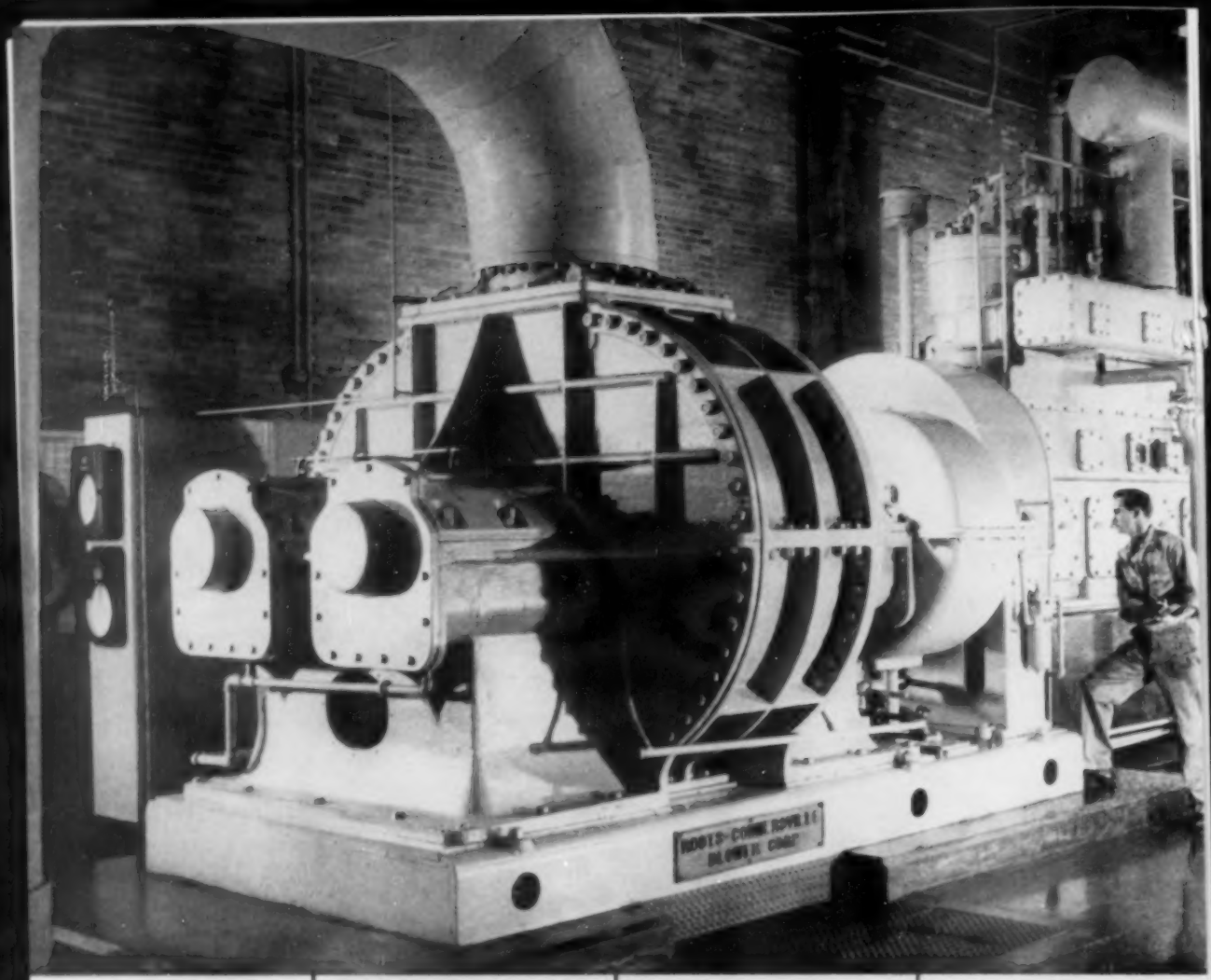

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SECURITY ENGINEERING DIVISION, Whittier, Calif., Dallas, Tex.—Rock bits, reamers, casing scrapers, reamer rock bits, coring bits, Securaloy.

Pacific Pumps inc.

PACIFIC PUMPS, INC., Huntington Park, Calif. — Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

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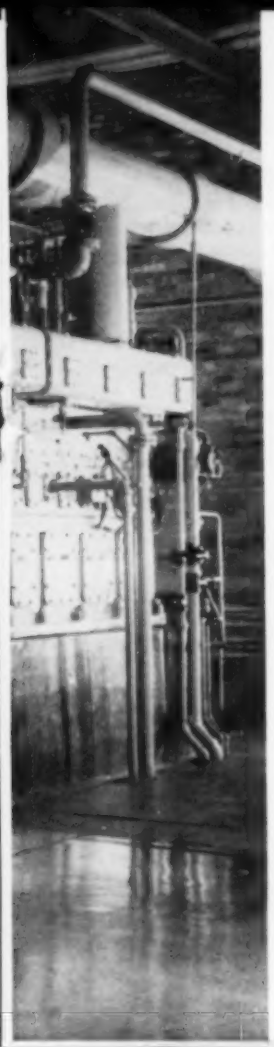
Now entering its second century of service, the Roots-Connersville Blower Division of Dresser Industries has pioneered the development of efficient equipment designed to move gas and air under moderate pressures. Roots-Connersville gas pumps, blowers and related products have won world-wide recognition for superior design and watch-like precision. Serving many industries, Roots-Connersville manufactures both rotary positive and centrifugal blowers and exhausters, plus an extensive line of gas and vacuum pumps, rotary positive displacement meters, and inert gas generators.



How the DRESSER *plus* + works...

Providing dependable, economical service to an important industrial area, a major Illinois utility company is backed up by an all-star Dresser team. Illustrated at left, a *Roots-Connersville* RCGH gas booster, driven by a *Clark* gas engine, compresses natural gas to 10 pounds per square inch gauge pressure at the rate of one million cubic feet per hour. Popular *Dresser* couplings – used to connect sections of the engine exhaust pipe – are also on the top-flight team putting the Dresser *plus* + to work at this natural gas pipe line booster station. Still more Dresser products work at other tasks in the same plant.

At thousands of industrial installations all over the world, many Dresser products work together in the growing task of producing and processing the fuels and chemicals vital to modern civilization. And behind each of these products stands the combined research, experience, and engineering facilities of all the Dresser companies.

You, too, can put the Dresser plus + to work for you when you use any Dresser product or service, *standard of comparison the world over.*

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.— Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, and positive displacement meters.

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MAGNET COVE BARIUM CORP., Houston, Tex., Malvern, Ark.— Magcobar and Magcogel drilling muds and other specialized oil well drilling fluids and chemicals.

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DRESSER-IDECO DIVISION, Columbus, Ohio — Radio and television broadcasting towers, steel buildings, aircraft hangars, mechanical parking garages, electric power substations.

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DRESSER INDUSTRIES, INC.

OIL, GAS AND CHEMICAL EQUIPMENT

ATLANTIC BUILDING • DALLAS, TEXAS

EDITORIALS . . .

The Refiners' Stake in the SAE

THE many activities of the Society of Automotive Engineers have embraced practically the entire period of existence of the automobile manufacturing industry. Without question, the Society has greatly influenced and guided the technological progress of that industry and therefore has played an important part in its overall growth.

The Society was founded in 1905 for the interchange of technical knowledge on developments in automotive transportation, first on land and later to include that on and under the sea and in the air. This dissemination of information is achieved through meetings and publications, through committee work and through selected research projects. Membership is by individuals only and active membership is limited to "competent practicing engineers of high repute".

Starting in 1917, when the SAE Fuels Division was organized, the automotive engineers and other technologists of the petroleum industry have shared in the fuels, and later the lubrication, activities of the Society. In 1933 the present Fuels and Lubricants Activity was formalized. The SAE and the API have their own jointly sponsored research organization, the Coordinating Research Council, for cooperative studies of fuels, lubricants and equipment powered by internal combustion engines. Work on standard test methods and specifications for automotive petroleum products in many instances is referred to Committee D-2 of the American Society for Testing Materials, where many of the same technologists from both industries participate in its activities. Thus the oil companies have come to have a considerable stake in the SAE affairs.

This cooperative work has greatly aided the refiners in anticipating the fuels and lubricants needed for the new model automobiles and aircraft and in providing them in commercial volumes when required. This activity alone warrants our congratulations to the SAE, now commemorating its 50 years of service to the automotive industry, and our wish for as high a degree of achievement of its aims in the years ahead.

Paint Won't Hide Your Poor Specs

PROTECTIVE paint coatings, properly formulated and applied, are a relatively inexpensive means of preventing atmospheric corrosion of structures and process equipment. But too many companies today consider painting in the category of a "necessary evil"—something to be lived with but which can be skimped on. Important items in surface preparation and application are eliminated for a relatively small net saving because the need for them is misunderstood.

If the painting in your plant is any concern of yours—either because you have to pay for it, be responsible for it, or live with it—we suggest you read the story "Cheap Painting Is No Bargain" starting on page 201 in this issue.

Then take a look at your own operations and see if you can't come up with some worthwhile suggestions on how they can be improved. Are your specifications for paint jobs drawn with the same intelligence, experience and care as those for a pump or new unit? Is full-time, qualified supervision provided on all paint jobs to make sure your specs are followed from start to finish? Do you keep accurate, detailed records on paint jobs—dates, costs, materials, methods of application, service life, and the like?

Only in this manner will you be assured of getting good protection from painting. And as it usually turns out when a sound plan is followed, the long-term cost will be appreciably reduced.

Are Autos Burning More or Less?

SINCE World War II the point has been many times debated as to whether the millions of passenger automobiles on the highways individually consume as much gasoline as in earlier years.

Those who said "No, they do not," relied in part on their own experiences in keeping away from casual and frequent pleasure driving because of the increasing traffic congestion. Seeing their own cars and those of their neighbors in the garage more weekend hours, they reasoned that automobiles were using less fuel.

The theory was supported by observations during the week also, of row after row of cars parked at plants and factories during working hours and presumably being used principally for the trips between home and work. Advocates of the negative side brought up the growing number of two-car families, where two automobiles would not be expected to use twice the amount of gasoline that had been used by the single car in the same family group.

Those who held the opposite view, cited the general movement to the suburbs as calling for even greater dependency on the passenger car to take men to work or to the railroad station, or to take children to and from school, or for doing the family shopping.

The debate has now been ended with presentation of factual data. A subcommittee of the American Petroleum Institute's Committee on Petroleum Statistics, using figures on gasoline consumption in the United States and data on passenger car, motor bus and motor truck registrations, has developed a formula for estimating the average annual consumption for each type of vehicle. Their data, published in the new 11th Edition of the API *Petroleum Facts and Figures*, shows:

Average consumption per passenger vehicle has risen from 671 gals. in 1946 to 694 gals. in 1953. Average usage by buses and trucks has gained in about the same proportion.

Thus the family car is established as a beast of burden more than ever before. Its useful occupations are more than making up for the lesser amount of purely "pleasure" driving. The oil company man who gloomily belived that highway congestion had been limiting the driving of cars, and consequently his gasoline sales, must readjust his sights.

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Specifications

Assay	99.9% SO_2
Molecular Weight	64.06
Melting Point	−103.9°F (−75.5°C)
Boiling Point	14.0°F (−10.0°C)
Specific Gravity	1.363 at 80°F
Critical Temperature	314.82°F (157.12°C)
Critical Pressure	1141.5 p.s.i.a.

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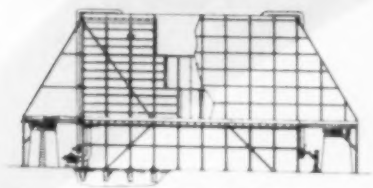
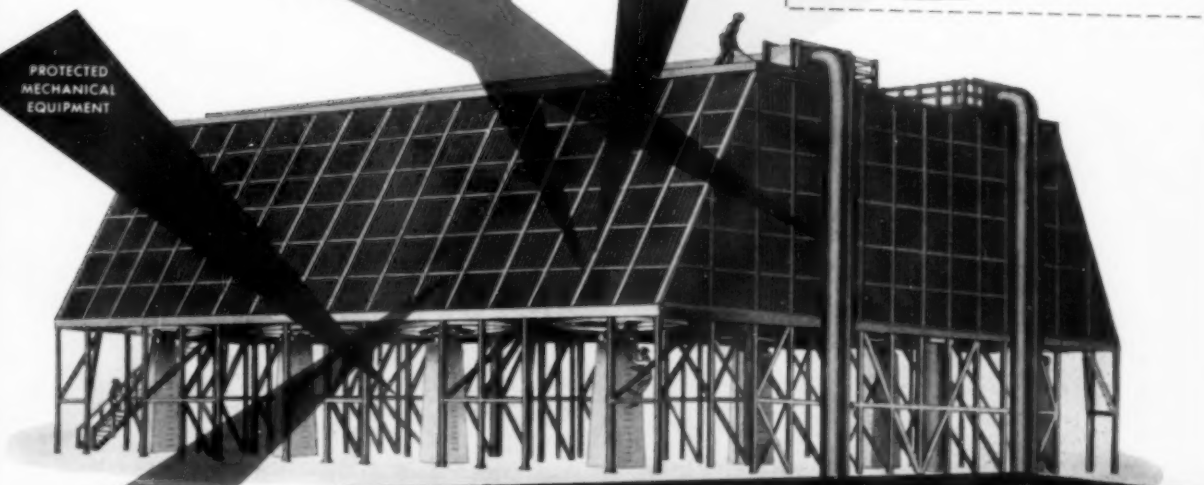


PROTECTED MECHANICAL EQUIPMENT



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